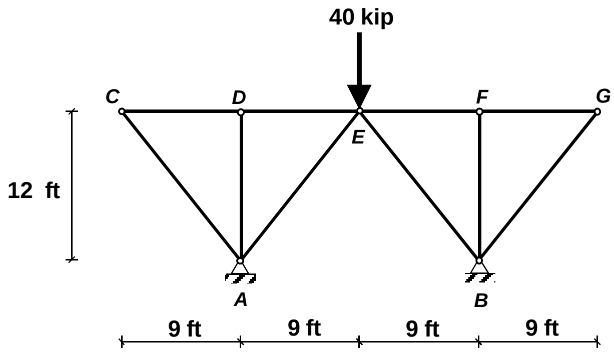
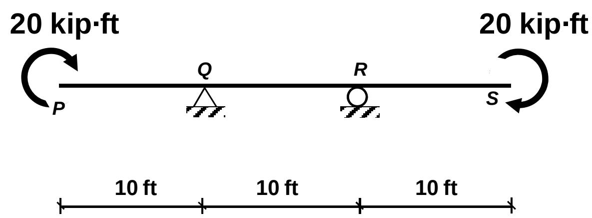
1) The truss shown below has pinned supports at *A* and *B*. Find the support reactions.



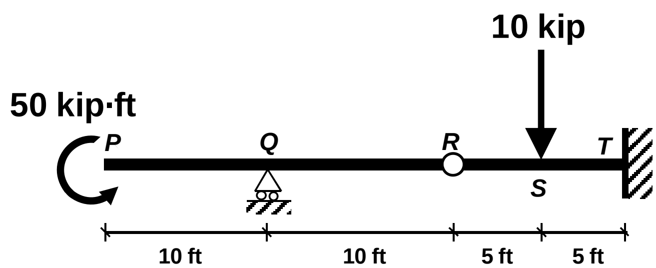

2) The 30-ft long beam shown below is acted upon by a pair of 20 kip-ft clockwise moments at its free ends. The beam has constant *EI* throughout.

a. Draw the bending moment diagram.
b. Sketch the deflected shape.



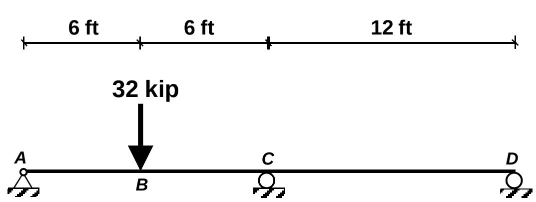

3) The beam shown below has a roller-support at *Q*, a fixed-support at *T*, and an internal hinge at *R*. It is loaded with a 50 kip-ft counter-clockwise external moment at its free end *P* and with a 10 kip downward load at *S*, i.e., half-way between the internal hinge and the fixed-support.

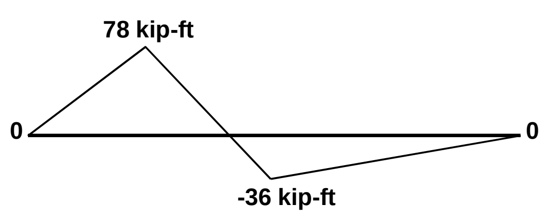
a. Find the support reactions.
b. Draw the shear force diagram.
c. Draw the bending moment diagram.
d. Sketch the deflected shape.




4) The beam *ABCD* is made out of a single prismatic element with constant *EI*. The bending moment diagram resulting from a downward concentrated load of 32 kips applied at *B* is given. Designer's sign convention –the one we used in class to graph beam moment diagrams– is used: moment is positive if bottom fibers are in tension and negative if top fibers are in tension.

a. Sketch the deflected shape.
b. Find the slope of the deflected beam at *D*.



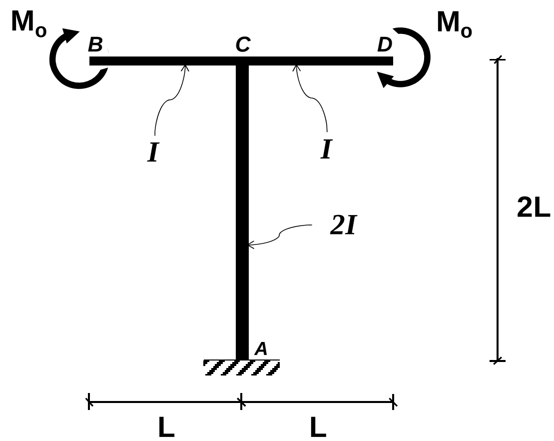

**[Bending moment diagram]**

5) The column segment *AC* of the welded T-frame shown below has twice the moment of inertia of the beam segment *BCD*. Both segments are made out of the same material with elastic modulus *E*. The support at *A* is a fixed-support; joint *C* is rigid.

The frame is loaded by a pair of clockwise moments $M_o$ at its free-ends *B* and *D*.

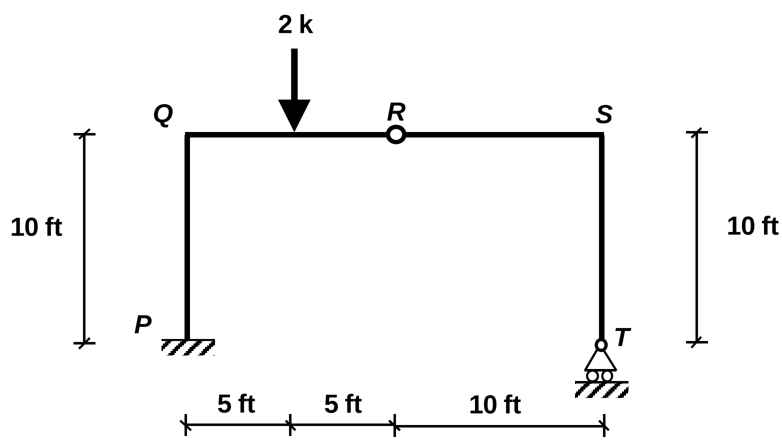
Consider flexural behavior only.

a. Draw the bending moment diagram.
b. Find the horizontal displacement at *C*.
c. Find the rotation at *C*.
d. Find the vertical displacement at *D*.
e. Find the rotation at *D*.
f. Sketch the deflected shape.




6) The frame shown below has a fixed-support at *P* and a roller-support at *T*. It has an internal hinge at *R*. Joints at *Q* and *S* are rigid. The frame is loaded at half-way between Q and *R* with a 2-kip point load acting downwards. Consider only flexural deformations, i.e. ignore axial and shear deformations. *EI* is constant throughout the structure.

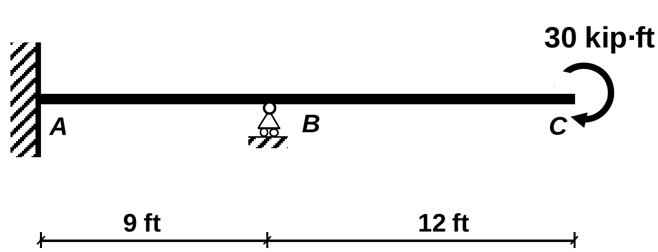
a. Find the support reactions.
b. Draw the bending moment diagram for the frame.
c. Sketch the deflected shape.
d. Find the horizontal displacement of joint *Q*.
e. Find the rotation of joint *Q*.
f. Find the vertical displacement at *R*.




7) The beam *ABC* shown below has a fixed support at *A* and sits on a roller support at *B*. It has constant *EI* throughout. A clockwise external moment of 30 kip-ft is acting on the beam at its free end *C*.

Use flexibility method (also known as compatibility of deformations approach or method of consistent deformations) to analyze the beam. Treat the reaction at support *B* as the redundant reaction.

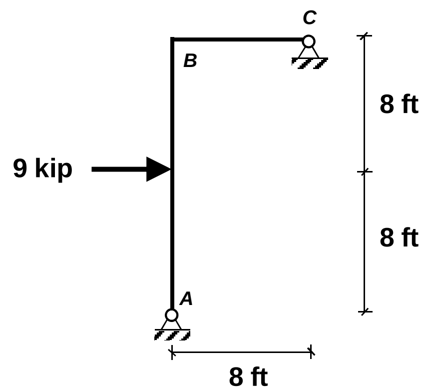
a. Find the reaction at *B*.
b. Find the reactions at A.
c. Draw the bending moment diagram.
d. Sketch the deflected shape.



8) The bent frame *ABC* has constant *EI* throughout. It has pinned supports at *A* and *C*, and a rigid joint at *B*. The frame is loaded at mid-height between *A* and *B* with a concentrated load of 9 kip acting towards right.

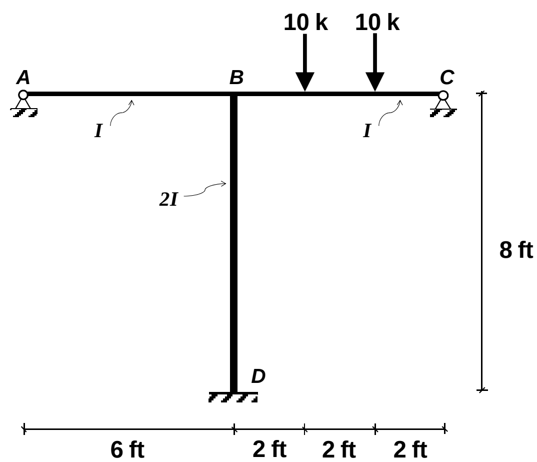
Analyze the structure using slope-deflection method.

a. Find the amount of rotation at *B*.




9) The T-frame shown below has two beam segments (each 6-ft long and with moment of inertia *I*) and a column segment (8-ft tall and with moment of inertia 2*I*) connected to each other with a rigid joint at *B*. Supports at *A* and *C* are pinned-supports. Support at *D* is a fixed-support. The structure is loaded by a pair of 10-kip point loads between *B* and *C* as shown below. Consider only flexural deformations, i.e. ignore axial and shear deformations. Modulus of elasticity is constant throughout the frame.

a. Using slope-deflection method, determine the member-end moments. (*Hint*: Where possible, use short-cut formulation to speed up the solution process.)
b. Draw the bending moment diagram.
c. Sketch the deflected shape.



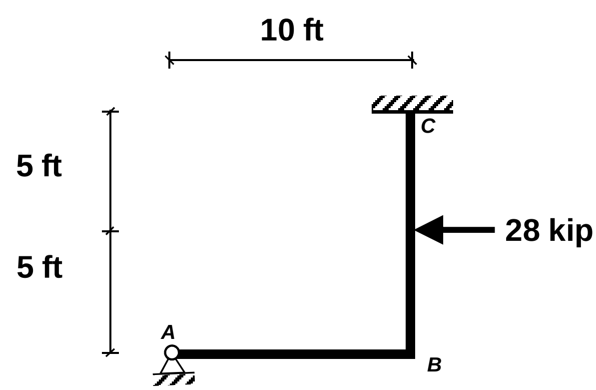

10) The bent-frame shown below has a pinned-support at *A* and a fixed-support at *C*. Joint *B* is rigid. *EI* is constant throughout the frame. A concentrated 28 kip load toward left is applied on the structure at half-way between *B* and *C*. Ignore axial and shear deformations. Consider flexural behavior only.

a. Indicate the degrees of freedom one would choose to analyze this structure reasonably accurately.

Use the slope-deflection method.

b. Find the rotation at *B*.
c. Find the member end moments.

d. Draw the bending moment diagram.
e. Sketch the deflected shape.



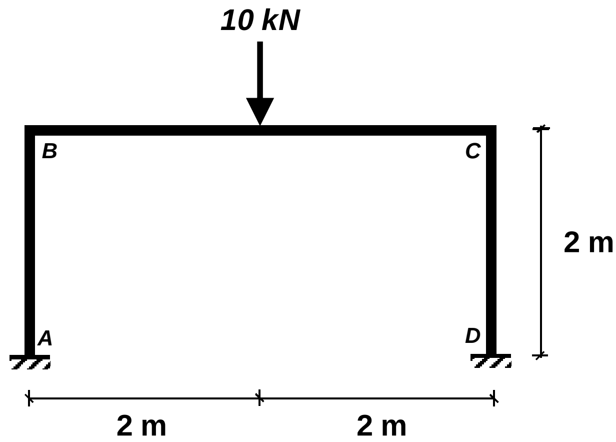
11) All segments of the portal frame shown below have identical *EI*. The supports at *A* and *D* are fixed-supports. A downward 10 kN concentrated load is applied at mid-span of segment *BC*.

Ignore axial and shear deformations. Consider flexural behavior only.

a. Indicate the degrees of freedom one would choose to analyze this structure reasonably accurately.

Use the slope-deflection method to analyze the structure. Note that due to symmetry in the structure and the loading, the structure does not sway.

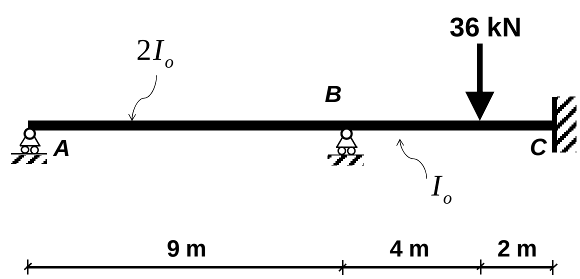
b. Find the rotation at *B* and the rotation at *C*.
c. Find the member end moments.
d. Draw the bending moment diagram.
e. Sketch the deflected shape.



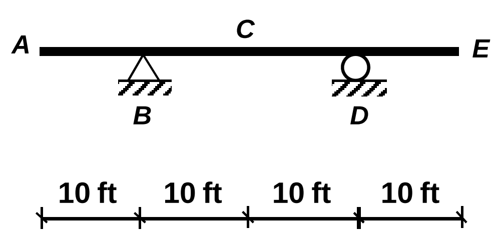

12) The beam *ABC* is made out of two segments welded together at *B*. As shown below, the moment of inertia of the beam sections in segment *AB* is twice that of those in segment *BC*, that is, $2I_o$ vs. $I_o$. The beam has roller supports at *A* and *B*, and a fixed support at *C*. Note that the beam is continuous over support *B*. 2 meters away from the fixed support, a 36 kN downward concentrated force is loading the beam.

Use moment-distribution method to analyze the structure.

a. Find the beam end moments for each segment.
b. Draw the bending moment diagram.
c. Find the reaction at *B*.
d. Sketch the deflected shape.




13) Consider the beam *ABCDE* shown below.




a. Find the influence line for vertical reaction at *B*. Which segment(s) should be loaded with uniform intensity distributed live load to obtain the maximum upward reaction at *B*?
b. Find the influence line for internal shear force at section *C*. *C* is located half-way between *B* and *D*. Which segment(s) should be loaded with uniform intensity distributed live load to obtain the maximum shear force at *C*?
c. Find the influence line for internal bending moment at *C*. Which segment(s) should be loaded with uniform intensity distributed live load to obtain maximum internal positive bending moment at *C*? Note that, per designer's sign convention, positive bending moment is a moment that causes tension at the bottom of beam.

14) The beam *ABCDE* shown below has a roller-support at *A* and a fixed-support at *E*. At *C*, the beam has an internal roller-support over which the beam is continuous. At *B* and *D*, the beam has internal pins (hinges). Distributed downwards live load with uniform intensity $\omega$ is to be applied on the beam.

a. Find the influence line for the reaction at *A*. Which segment(s) should be loaded with the distributed uniform intensity live load to maximize upward reaction at *A*?
b. Find the influence line for the reaction at *C*. Which segment(s) should be loaded with the distributed uniform intensity live load to maximize upward reaction at *C*?
c. Find the influence line for the vertical reaction at *E*. Which segment(s) should be loaded with the distributed uniform intensity live load to maximize the upward vertical reaction at *E*?
d. Find the influence line for the moment reaction at *E*. Which segment(s) should be loaded with the distributed uniform intensity live load to maximize the moment reaction at *E*?
e. If the beam is loaded along its full length with 2 kips/ft uniform load, i.e., all segments are loaded with 2 kips/ft uniform load, what will be the moment reaction at *E*?