Problem 1 *(10 points)*

Consider a three-member truss as shown. Members (1), (2) and (3) are pinned to the wall at H, D, and, B, respectively, and pinned to each other at C. The orientations, lengths, Young's modulus and cross section areas are shown in the figure. A point force P is applied to joint C. It is desired to determine the axial load carried by the three members. Note that all members in the truss are two-force members.

- Write down the equilibrium equations for joint C. Can the axial forces in the members be found from these equilibrium equations alone? Explain your reasoning.
- Write down the force-elongation equations for the three members.
- Write down the compatibility relations between elongation of members (1), (2), (3) and the horizontal and vertical displacements (u_C, v_C) of connector C.
- Calculate the axial loads in the members, and horizontal and vertical displacements (u_C, v_C) of joint C.

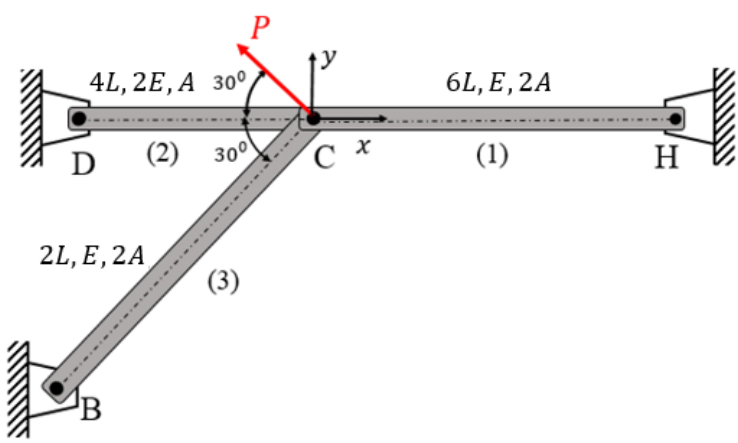
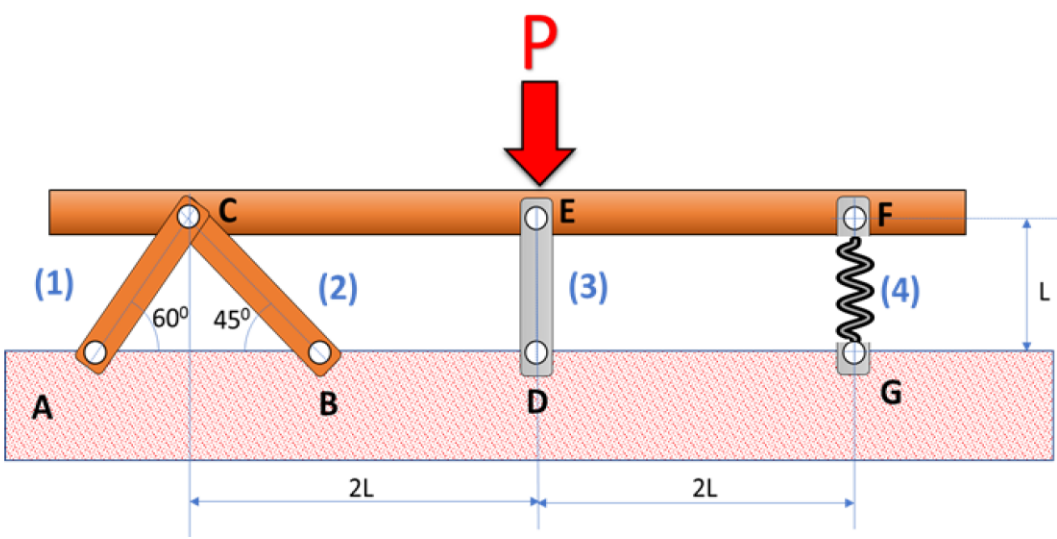


Figure 1

Problem 2 ***(10 points)***

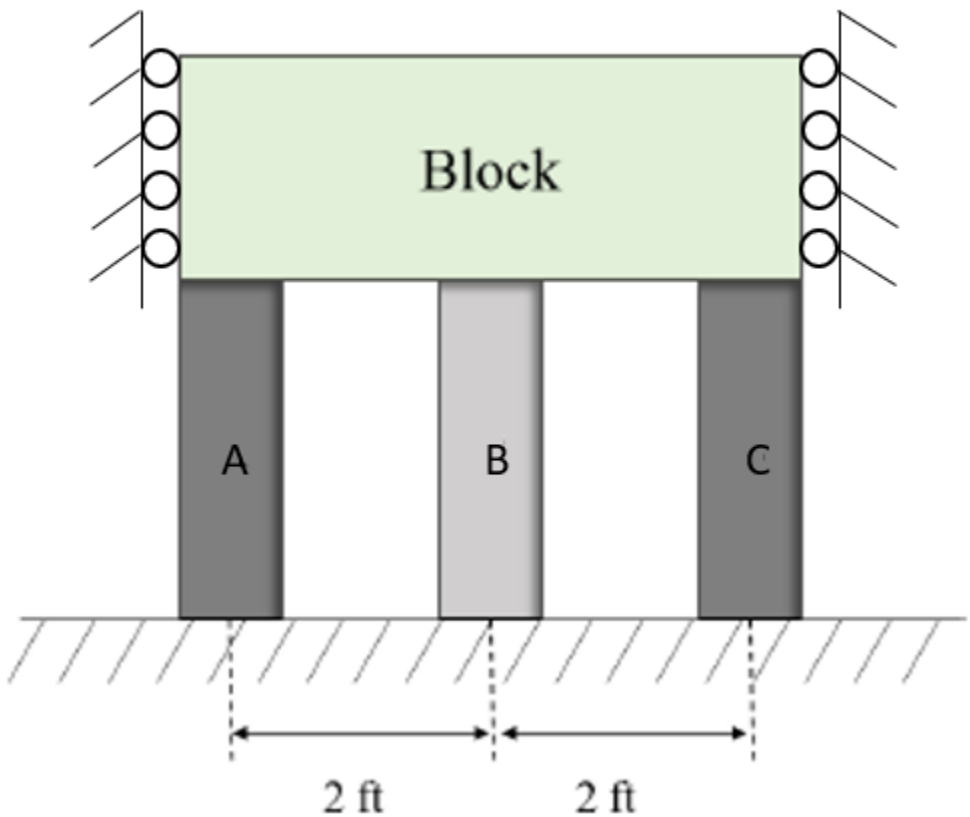
A rigid platform CEF is supported by a four-supports configuration as shown in figure. All joints are pinned and a load P acts downward at D. Member ABDG is fixed. Assume that members (1) and (2) are **rigid supports**, member (3) has a cross sectional area A and an elastic modulus of E, and member (4) is made of a spring with the stiffness k.
Hint: The magnitude of the restoring force exerted by a spring is given by $|\vec{F}| = kx$, where k is the stiffness of the spring and x is the deformation.

- Calculate the internal forces in each member.
- Calculate the deformation of members (3) and (4).
- Calculate the deformation of member (3), if the member (4) is removed.



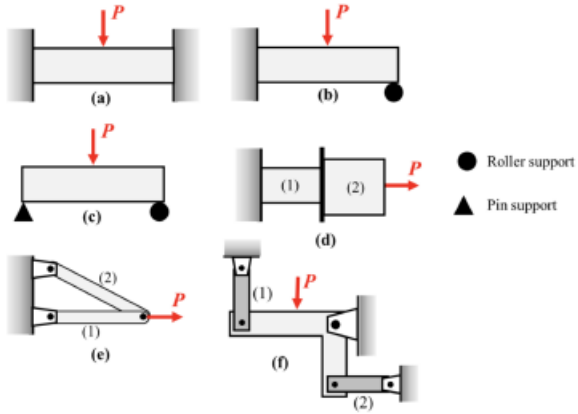
Problem 3 ***(10 points)***

A rigid block with a weight of 80×10^3 lbs is supported by posts A, B, and C. The block is attached to the posts at all times and is constrained by roller supports on the left and right sides. The Young's modulus for posts A and C is $E_A = E_C = 29 \times 10^3 ksi$, and that for post B is $E_B = 14.5 \times 10^3 ksi$. All posts have the same initial length before loading with a cross-sectional area of $8in^2$. After heating post B, its temperature increased by $20^o F$ while the temperature of A and C is held constant. The coefficient of thermal expansion for post B is $\alpha_B = 9.8 \times 10^{-6} F^{-1}$. Determine the normal stress in each post before and after heating post B.

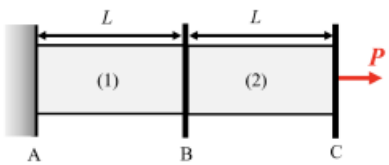


Problem 4 ***(2.5 + 2.5 + 2.5 points)***

a) Out of the six structures (a)-(f) below, indicate the statically indeterminate ones.



b) The rod consists of elements (1) and (2) and rigid connectors B and C. Both elements have length L and cross-sectional area A. Element (1) has Young's modulus E_1, and element (2) has Young's modulus E_2, with $E_1 < E_2$



Let F_1 and F_2 represent the axial forces in members (1) and (2). Choose the correct option:

- $F_1 > F_2$
- $F_1 = F_2$
- $F_1 < F_2$
- Insufficient information

c) For the configuration in b), let δ_1 and δ_2 be the axial deformations in members (1) and (2) respectively. Choose the correct option:

- $\delta_1 > \delta_2$
- $\delta_1 = \delta_2$
- $\delta_1 < \delta_2$
- Insufficient information