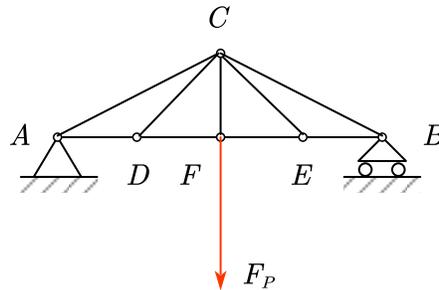
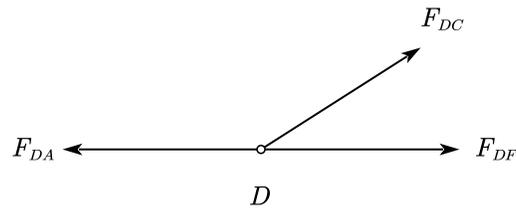


## Homework #2 Solution

**Problem 1:** Find the zero force members in the following truss structure.



Draw a free body diagram at joint D (assume all members are in compression):

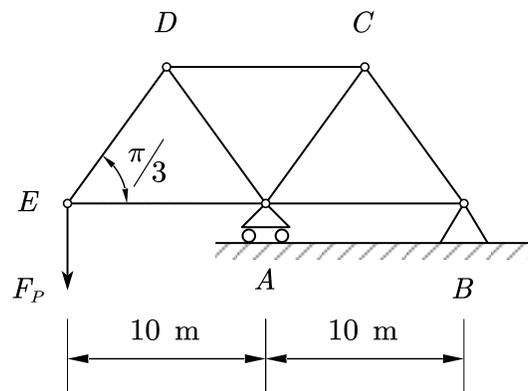


If there is a force in member DC (i.e.  $F_{DC} \neq 0$ ), the  $\sum F_y = 0$  can NOT be accomplished because there are no other forces to balance the vertical component of  $F_{DC}$ . Therefore, the  $F_{DC}$  must be zero.

Similar logic can be applied in joint E.

Thus, members with zero force in the structure are **CD** and **CE**.

**Problem 2:** If the maximum force that any member can support is 10 kips in tension and 7 kips in compression, determine the maximum force  $F_P$  can be applied on the following structure (all the angles are  $\pi/3$ ).

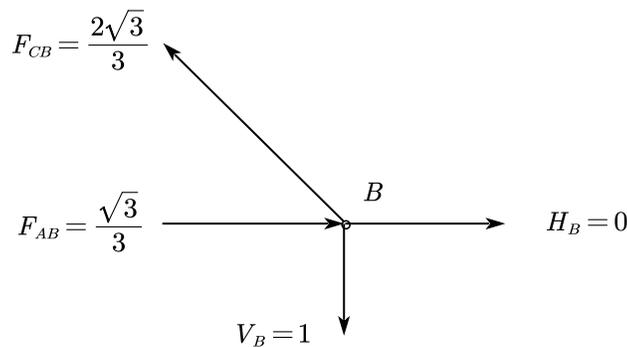
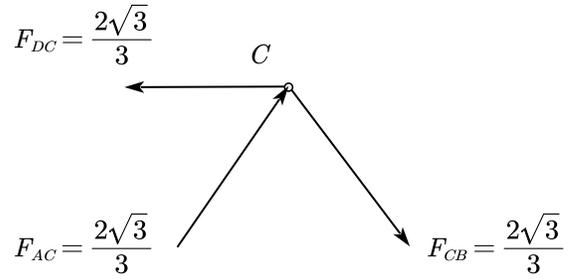
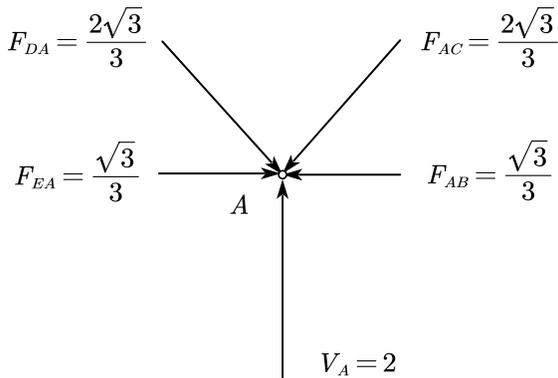
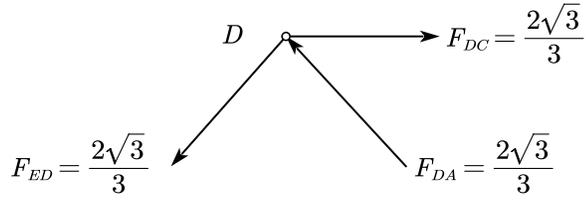
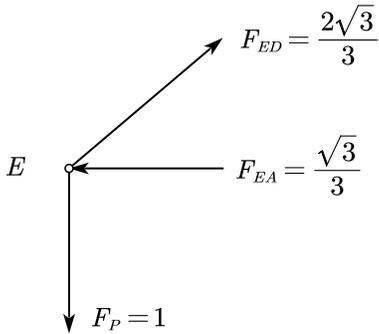


Use *method of superposition* for this linear elastic structure and assume  $F_p=1$  kips, the vertical reaction forces at A and B are:

$$\sum M_A=0, F_p \cdot 10 = V_B \cdot 10, V_B = F_p = 1 \text{ kips } (\downarrow)$$

$$\sum F_y=0, -F_p + V_A - V_B = 0, V_A = 2 \text{ kips } (\uparrow)$$

use *method of joint* to calculate the force in each member starting from joint E:

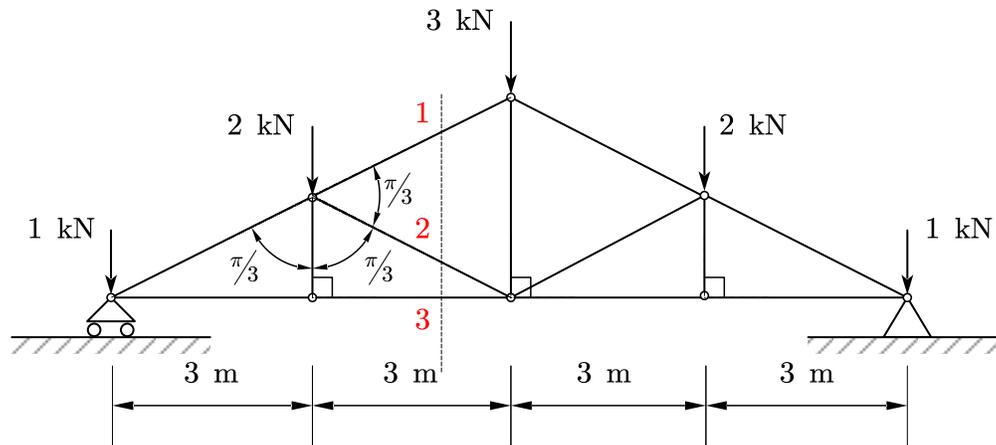


Thus, the maximum compression force will result in member AD, AC with a value of  $2\sqrt{3}/3$  ;

The maximum tension force will result in member ED, CB with a value of  $2\sqrt{3}/3$  .

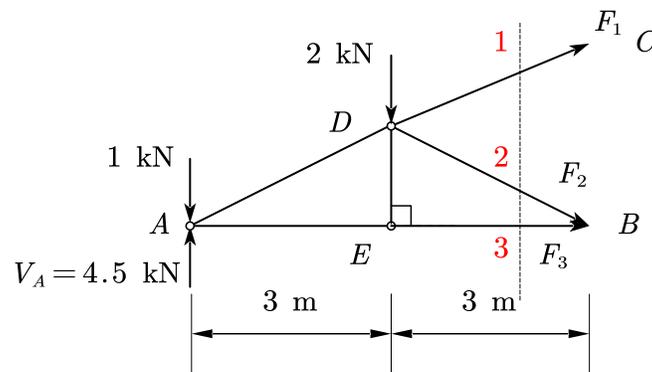
So, the compression controls, and the maximum  $F_p = \frac{7 \text{ kips}}{2\sqrt{3}/3 \text{ kips}} \cdot 1 \text{ kips} = 6.06 \text{ kips}$  .

**Problem 3:** Use *method of section* to solve for the forces in members 1, 2 and 3.



(1) the structure is symmetric about the center line; thus, the vertical reaction forces are equal with a value of  $9/2$  kN and there will be no horizontal reaction force due to equilibrium.

(2) Use *method of section*; draw free body diagram as following assuming forces in member 1, 2 and 3 are in tension:



$$\sum M_B = 0, \quad 1 \times 6 + 2 \times 3 = V_A \cdot 6 + F_1 \cdot d_1$$

$$\text{where, } d_1 = 3$$

$$\Rightarrow F_1 = -5 \text{ kN}$$

$$\sum M_D = 0, \quad 1 \times 3 + F_3 \cdot d_2 = V_A \cdot 3$$

$$\text{where, } d_2 = \sqrt{3}$$

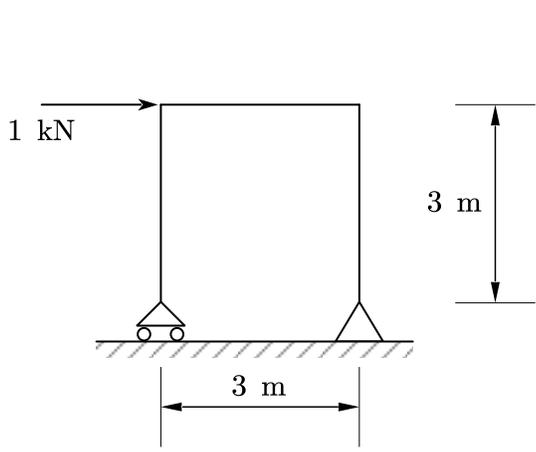
$$\Rightarrow F_3 = \frac{10.5}{\sqrt{3}} = 6.06 \text{ kN}$$

$$\sum M_E = 0, \quad 1 \times 3 = V_A \cdot 3 + F_1 \cdot d_3 + F_2 \cdot d_4$$

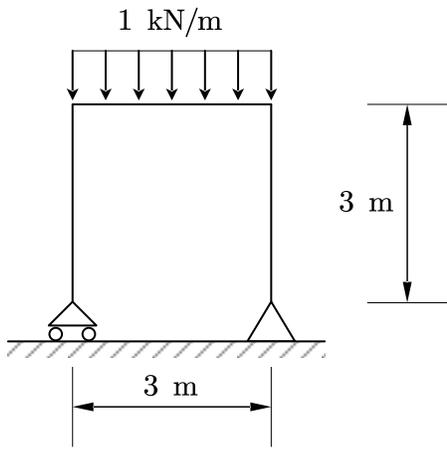
$$\text{where, } d_3 = \frac{3}{2}, \quad d_4 = \frac{3}{2}$$

$$\Rightarrow F_2 = -2 \text{ kN}$$

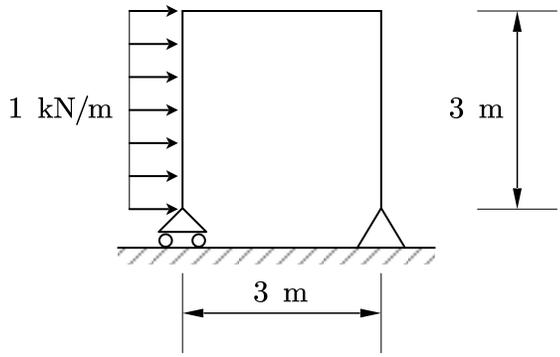
**Problem 4:** Plot the moment diagram for the following structures. Please include essential calculation details.



(a)

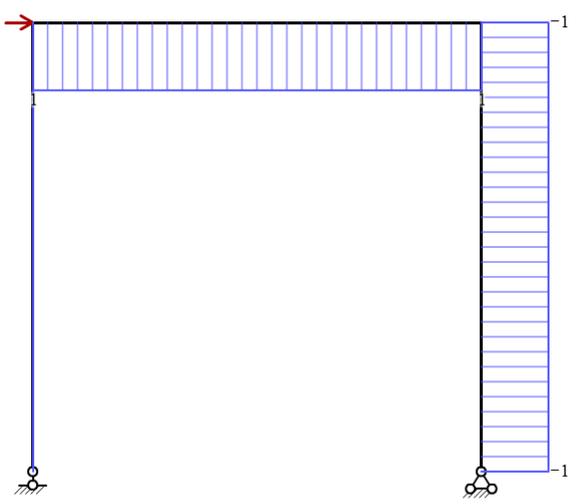


(b)

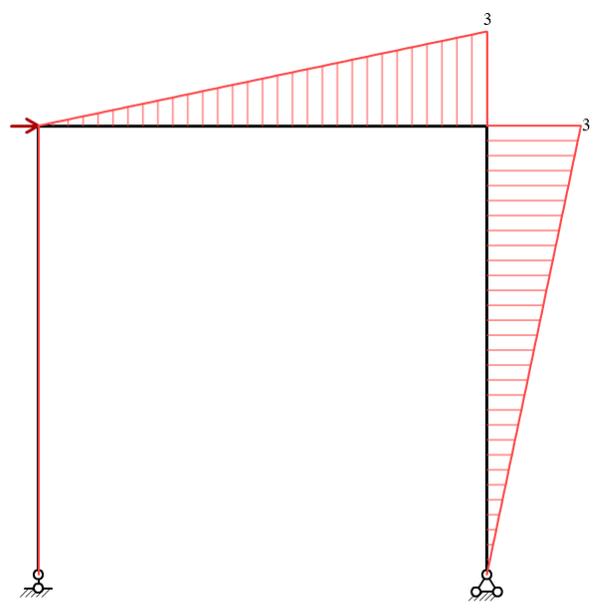


(c)

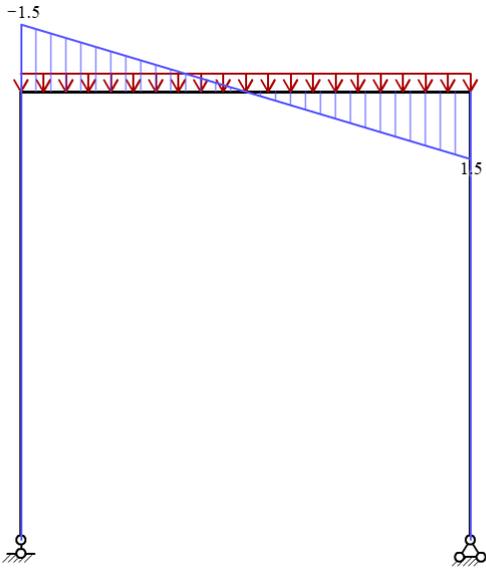
(a) Shear Force Diagram (SFD):



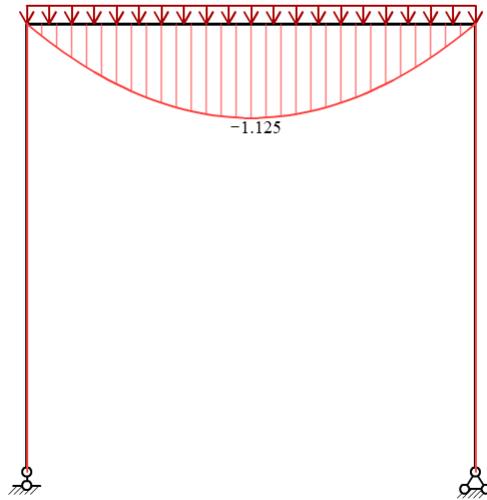
Bending Moment Diagram (BMD):



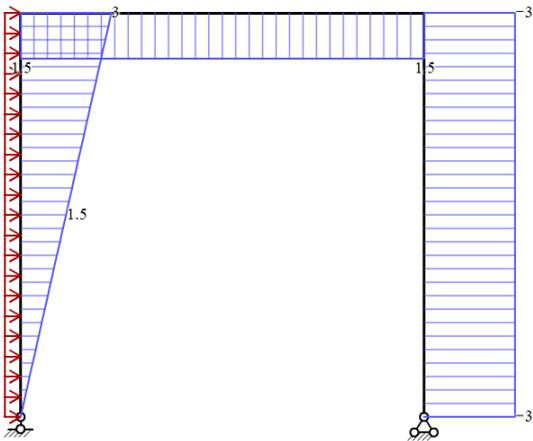
(b) Shear Force Diagram (SFD):



Bending Moment Diagram (BMD):



(c) Shear Force Diagram (SFD):



Bending Moment Diagram (BMD):

