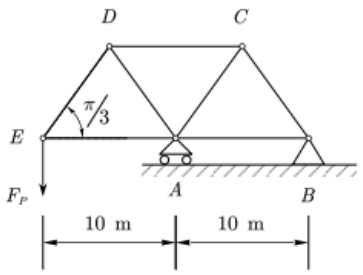
Problem 1: If the maximum force that any member can support is 10 kN in tension and 7 kN in compression, determine the maximum force F_P can be applied on the following structure (all the angles are π/3).

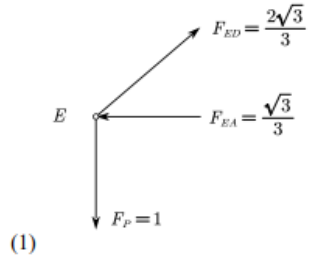


Use *method of superposition* for this linear elastic structure and assume F_P= 1 kN , the vertical reaction forces at A and B are:

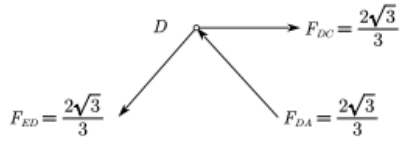
$$\sum M_A=0,\ F_P*10=V_B*10,\ V_B=F_P=1\ \text{kN}\ (\downarrow)$$

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

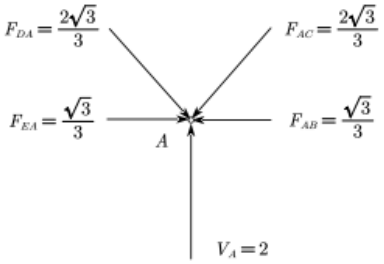
use *method of joint* to calculate the force in each member starting from joint E:



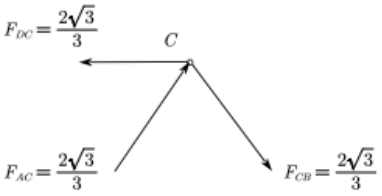
(1)



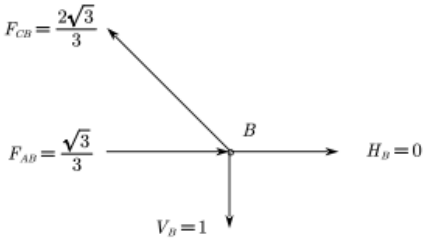
(2)



(3)



(4)



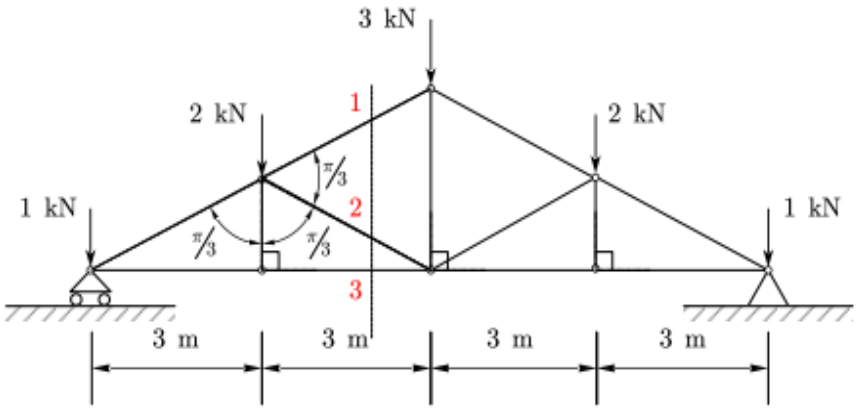
(5)

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 $2\sqrt{3}/3$.

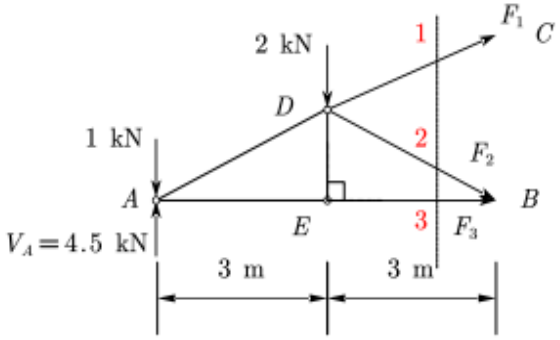
So, the compression controls, and the maximum $F_P = \frac{7\ \text{kN}}{2\sqrt{3}/3\ \text{kN}} \cdot 1\ \text{kN} = 6.06\ \text{kN}$

Problem 2: 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:



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

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

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

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

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

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

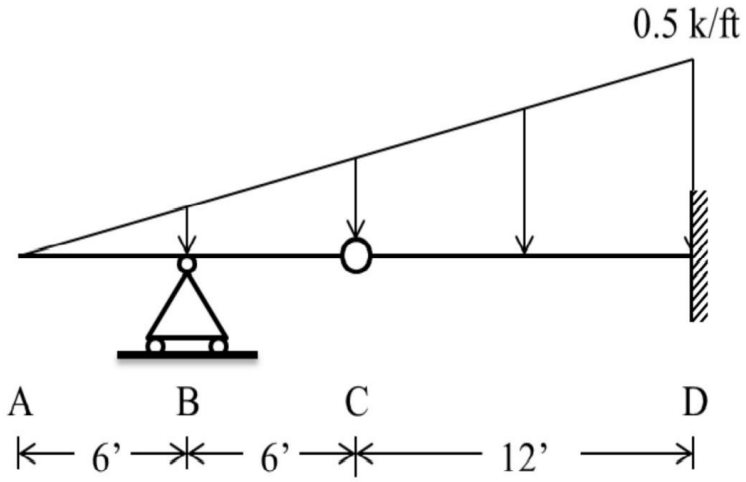
$$\sum M_E = 0,\ 1\times 3 = V_A \cdot 3 + F_1 \cdot d_3 + F_2 \cdot d_4$$

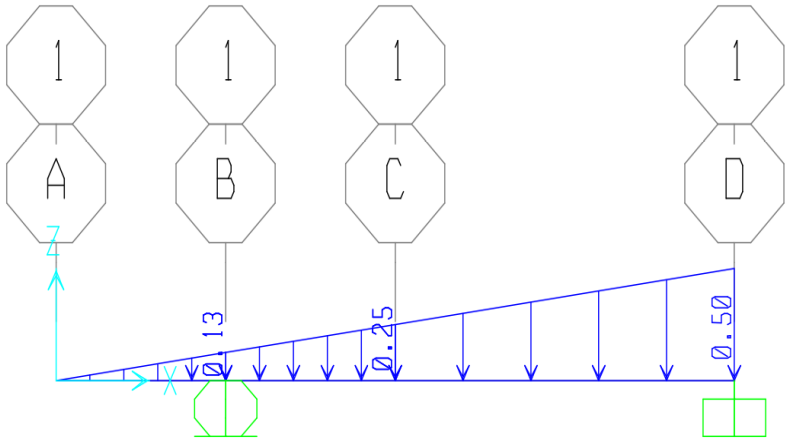
$$\text{where, } d_3 = \frac{3}{2},\ d_4 = \frac{3}{2}$$

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

Problem 3:

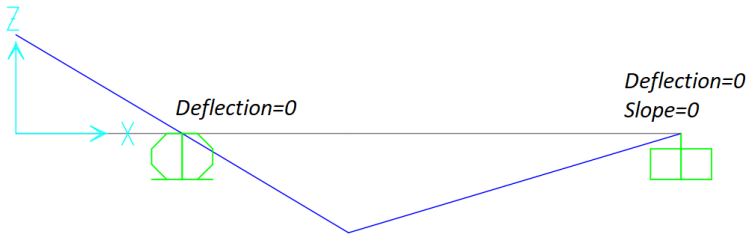
Determine the shear and moment throughout the beam. Draw the shear and moment diagrams for the beam. Draw the deflected shape of the beam.



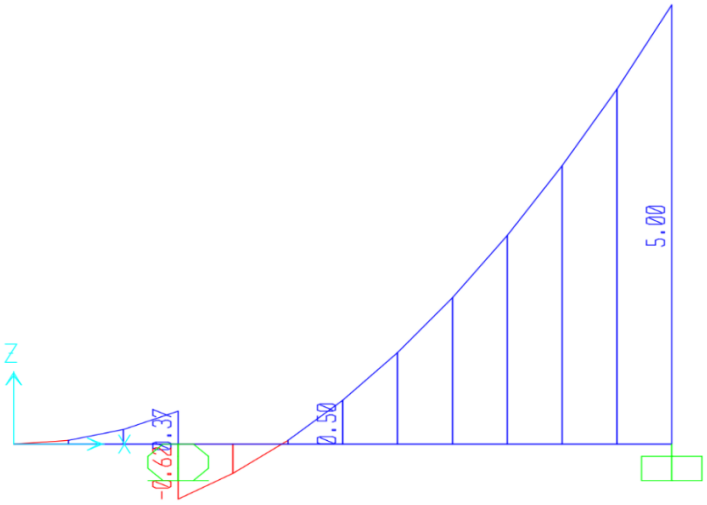


Reactions: $R_B = 1$ kips, $R_D = 5$ kips

Deflected Shape:



Shear Diagram: $V_A = 0, V_{B,left} = 0.375$ kips, $V_{B,right} = -0.625$ kips, $V_C = 0.5$ kips, $V_D = 5$ kips



Moment Diagram: $M_A = 0, M_B = -0.75$ kips. ft, $M_C = 0, M_D = -30$ kips. ft