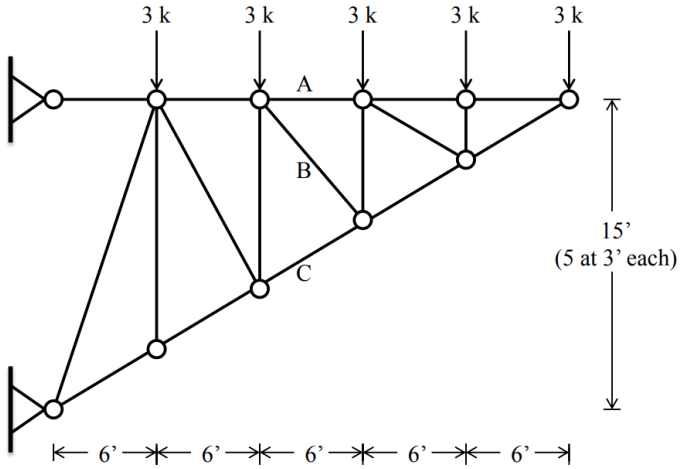
ENCE 353 Introduction to Structural Analysis Spring Semester, 2024

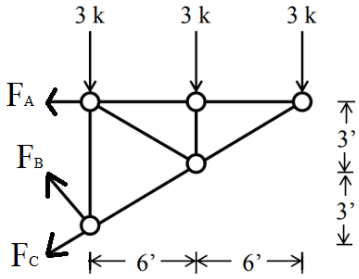
Homework 2

Due: 11.59 pm, February 23, 2024

Question 1: 5 points

Using method of sections, determine the forces in members A, B, and C. State if the members are in tension or compression.





$$\sum \mathrm{F_x} = 0 \rightarrow F_A + \frac{6}{\sqrt{72}} F_B + \frac{6}{\sqrt{45}} F_C = 0$$

$$\sum \mathrm{F_y} = 0 \rightarrow \frac{6}{\sqrt{72}} F_B - \frac{3}{\sqrt{45}} F_C - 9 = 0$$

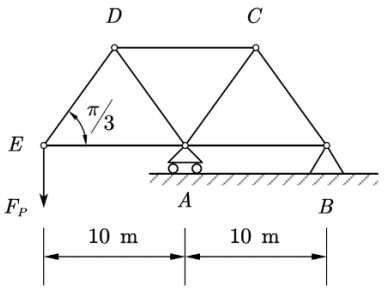
$$\sum \mathrm{M_{BC}} = 0 \rightarrow F_A(6) - 3(6) - 3(12) = 0$$

$F_A = 9\ kips, F_B = 4.24\ kips, F_C = -13.42\ kips$

Members A and B are in tension, and member C is in compression.

Question 2: 10 points

If the maximum force that any member can support is 17 kips in tension and 12 kips in compression, determine the maximum force F_P can be applied on the following structure (all the angles are $\pi/3$).

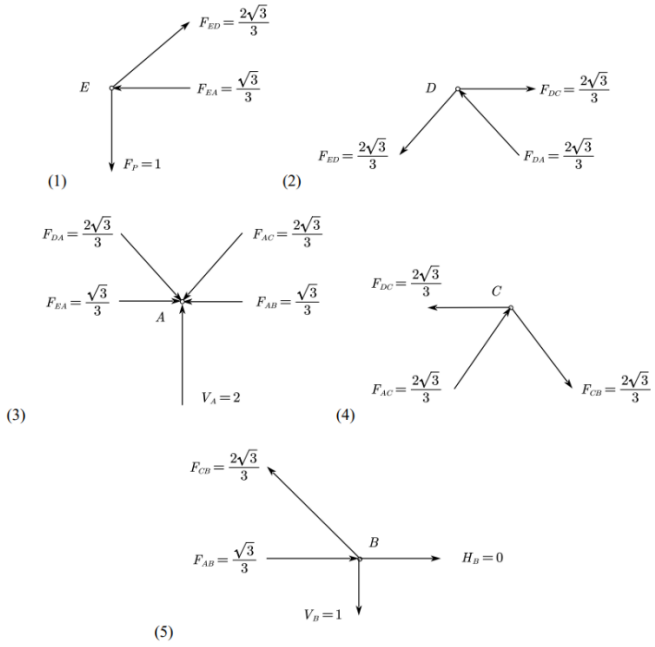


Use method of superposition for this linear elastic structure and assume $F_P = 1\ kips$, the vertical reaction forces at A and B are:

$$\sum \mathrm{M_A} = 0 \rightarrow V_B = 1\ kips\ (downward)$$

$$\sum \mathrm{F_y} = 0 \rightarrow V_A = 2\ kips\ (upward)$$

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



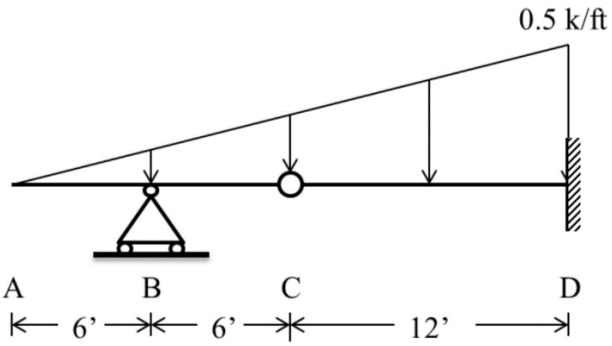
Hence, the maximum tension and compression forces are the same and have the value of $\frac{2\sqrt{3}}{3}$

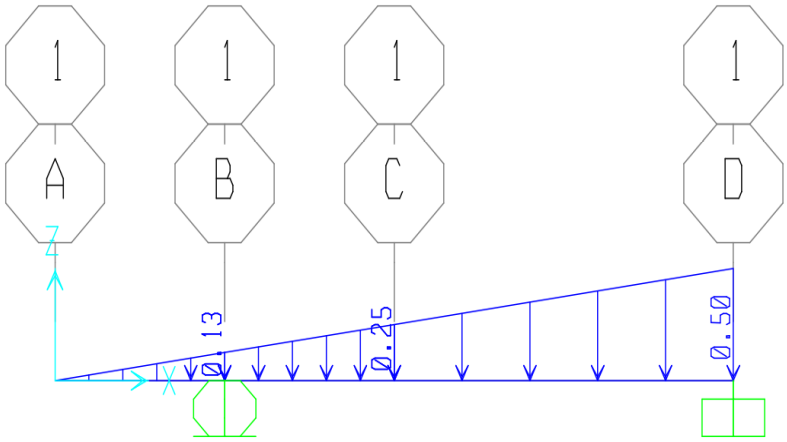
Therefore, the compression controls, and the maximum possible value for F_P is calculated as follows:

$$F_P = \frac{12}{\frac{2\sqrt{3}}{3}} * 1 = \frac{18}{\sqrt{3}} = 6\sqrt{3} = 10.4\ kips$$

Question 3: 15 points

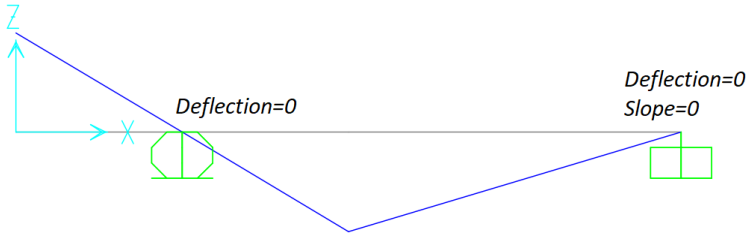
Determine the shear and moment throughout the beam. Draw the shear and moment diagrams for the beam. Draw the deflected shape of the beam.



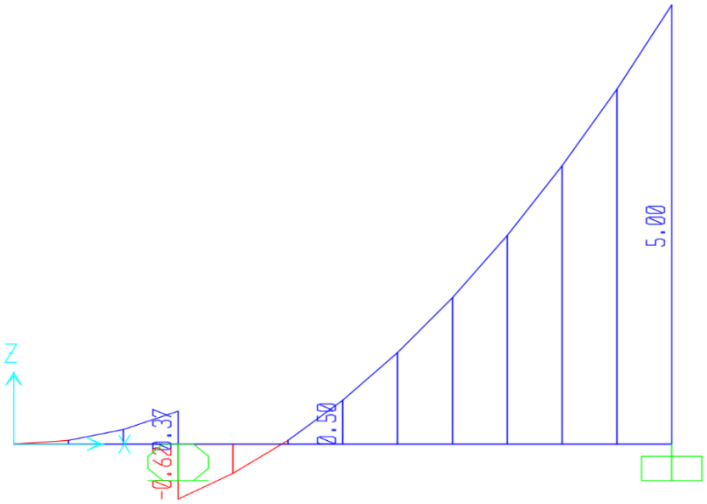


Reactions: $R_B = 1$ kips, $R_D = 5$ kips

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