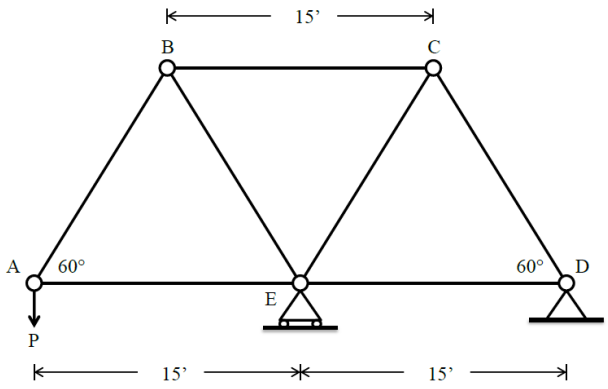
Homework 2

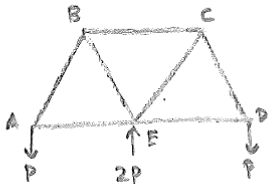
Due: October 4, 2019

Note: Please submit a neat piece of work. Show all the work.

1. If the maximum force that any member can support is 8 kips in tension and 5 kips in compression, determine the maximum force P that can be supported at joint A.



$T_{max} = 8\ k \quad C_{max} = 5\ k$



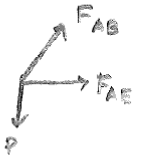
Due to symmetry

$F_{AB} = F_{ED}$

$F_{AE} = F_{DE}$

$F_{BE} = F_{CE}$

Joint A



$\pm \Sigma F_x = 0: \quad F_{AB}\cos 60 + F_{AE} = 0$

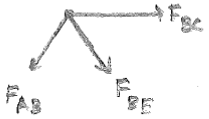
$+\uparrow \Sigma F_y = 0: \quad F_{AB}\sin 60 - P = 0$

$\Rightarrow$

$F_{AE} = -\dfrac{P}{\tan 60}$

$F_{AB} = \dfrac{P}{\sin 60}$

Joint B



$\pm \Sigma F_x = 0: \quad -F_{AB}\cos 60 + F_{BE}\cos 60 + F_{BC} = 0$

$+\uparrow \Sigma F_y = 0: \quad -F_{AB}\sin 60 - F_{BE}\sin 60 = 0$

$\Rightarrow$

$F_{BC} = \dfrac{2P}{\tan 60}$

$F_{BE} = -\dfrac{P}{\sin 60}$

Solve for smallest P

$F_{AB} = F_{CD} = \dfrac{P}{\sin 60} = 8 \quad \Rightarrow P = 6.93\ k$

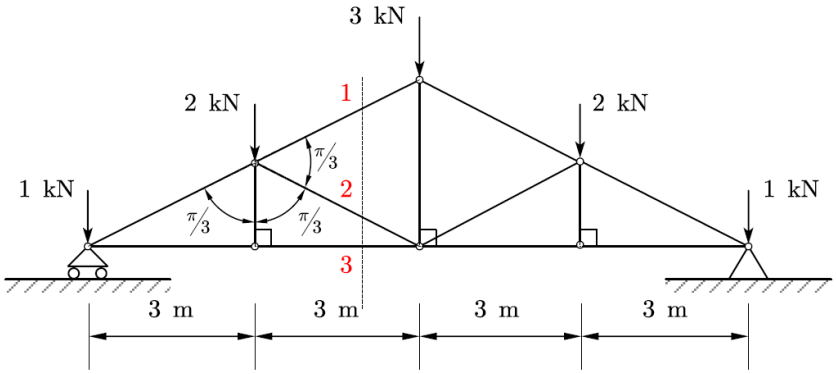
$F_{AE} = F_{DE} = -\dfrac{P}{\tan 60} = -5 \quad \Rightarrow P = 8.66\ k$

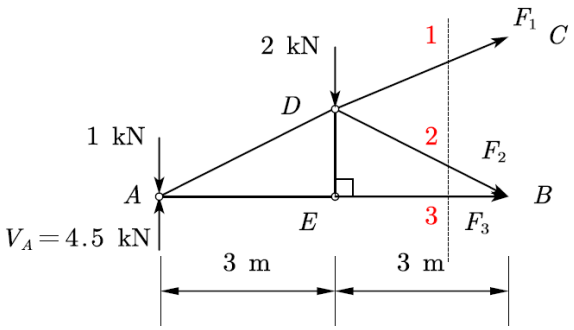
$F_{BC} = \dfrac{2P}{\tan 60} = 8 \quad \Rightarrow P = 4.33\ k$

$F_{BE} = F_{CE} = -\dfrac{P}{\sin 60} = -5 \quad \Rightarrow P = 4.33\ k$

$\Rightarrow \boxed{P_{max} = 4.33\ k}$

2. Use method of sections to solve for the forces in member 1,2 and 3.





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

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

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

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

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

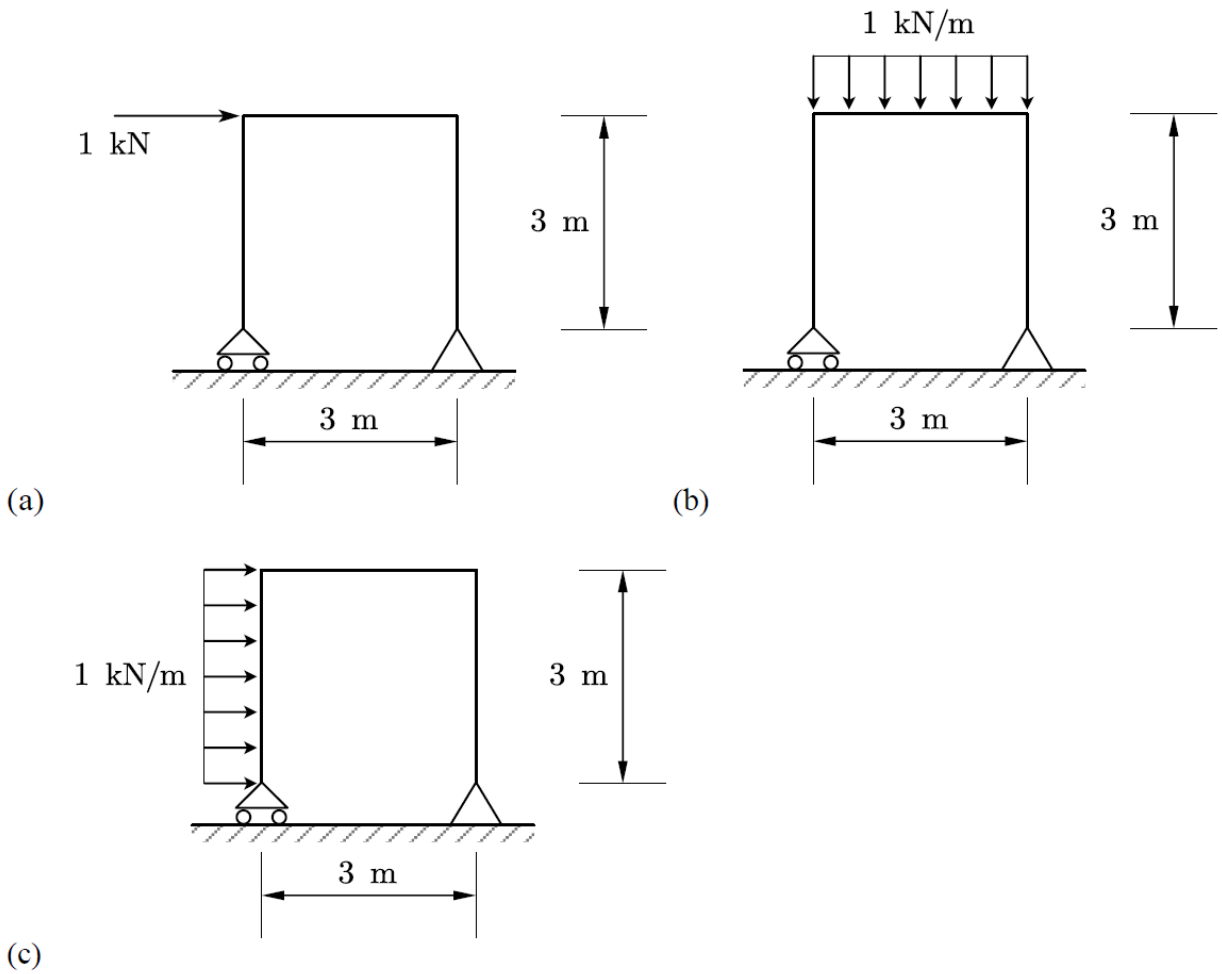
$$\Rightarrow F_3 = \frac{10.5}{\sqrt{3}} = 6.06 \text{ kN}$$

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

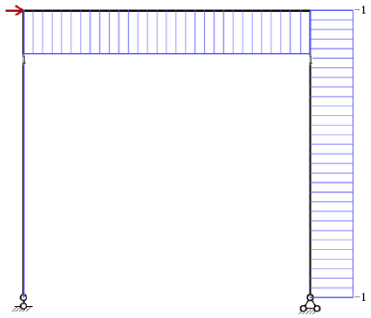
$$\text{where, } d_3 = \frac{3}{2},\ d_4 = \frac{3}{2}$$

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

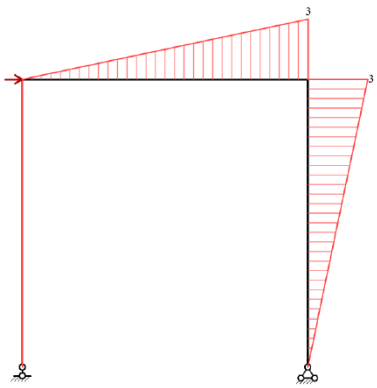
3. Plot moment diagram for the following structures. Please show all the work.



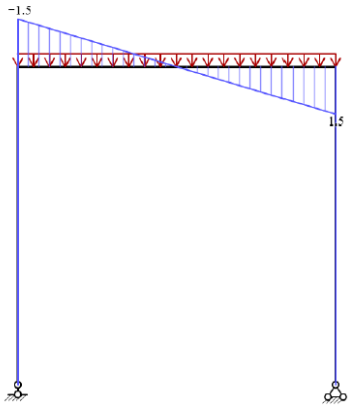
(a) Shear Force Diagram (SFD):



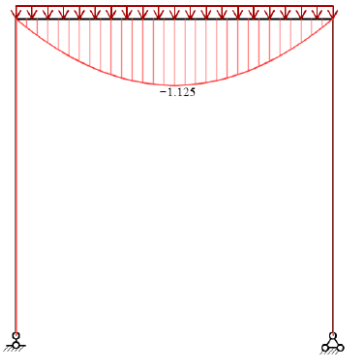
Bending Moment Diagram (BMD):



(b) Shear Force Diagram (SFD):



Bending Moment Diagram (BMD):



(c) Shear Force Diagram (SFD):

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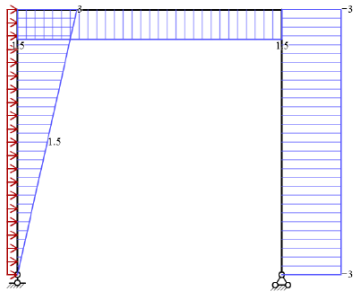

Bending Moment Diagram (BMD):