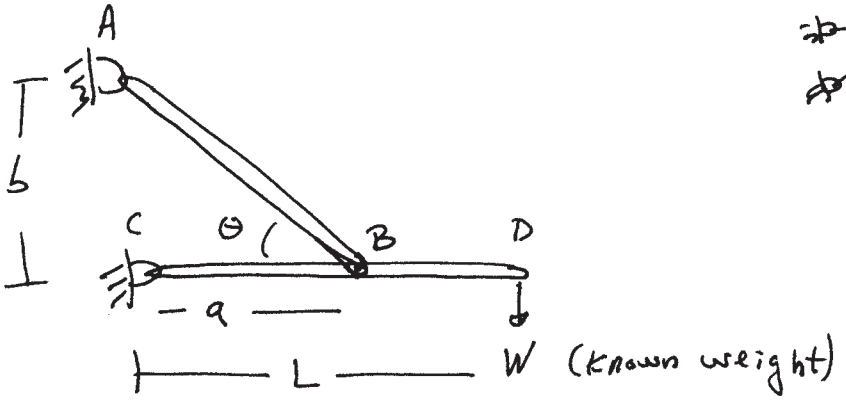
Statics Review for AEM 250

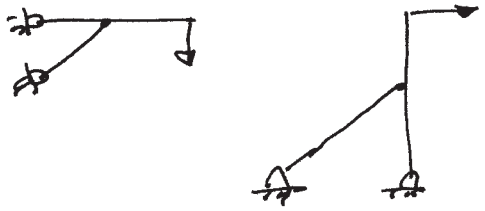
In Mechanics of Materials, almost every problem starts with determining forces & reactions on structures.

The following worked examples are meant to help review solution techniques from STATICS that are important in Mechanics of Materials.

Find F_{AB}

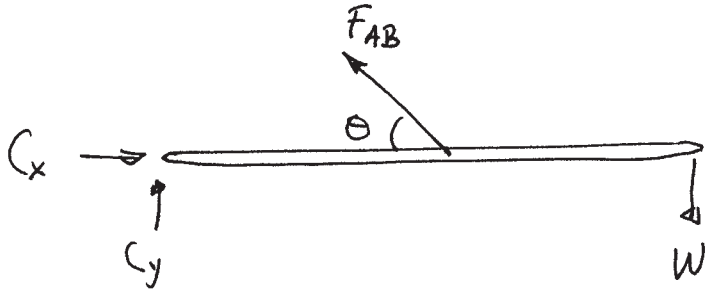
Note: these problems are solved the same way:





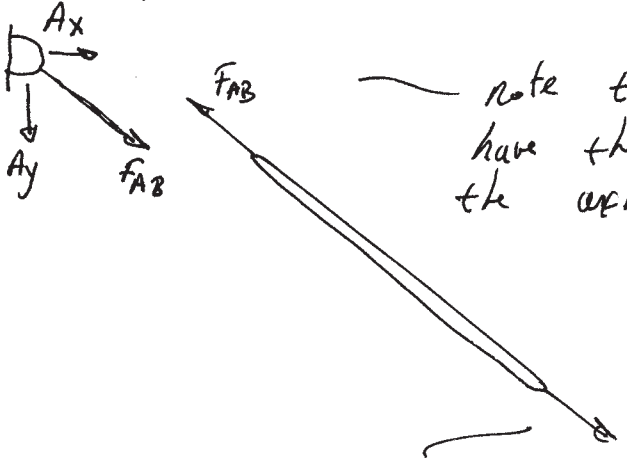
- BAR AB is a two-force member, because it is pinned on both ends.
- A two-force member has its resultant force directed along its axis.
- If we want to find F_{AB}, we need to remove the bar from the structure & replace it with a force arrow.

FBD of horizontal bar:



- Note that the pin @ C can support two perpendicular forces. For convenience, we will take them to be horizontal (C_x) & vertical (C_y).
- Since bar AB is a two force member, the force (F_{AB}) is directed at the angle θ.

FBD of bar AB

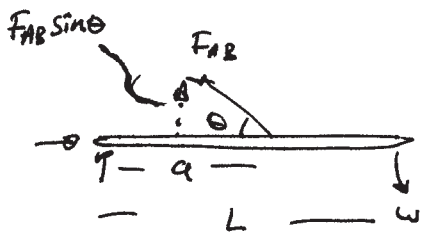


note that the pin reactions at A have the resultant of F_{AB}, directed along the axis of the bar: $F_{AB} = \sqrt{A_x^2 + A_y^2}$

note how this is equal & opposite of the force on the horizontal bar

- We have assumed bar AB to be in tension

$$\tan\theta = \frac{b}{a} \quad ; \quad \theta = \tan^{-1}\frac{b}{a}$$

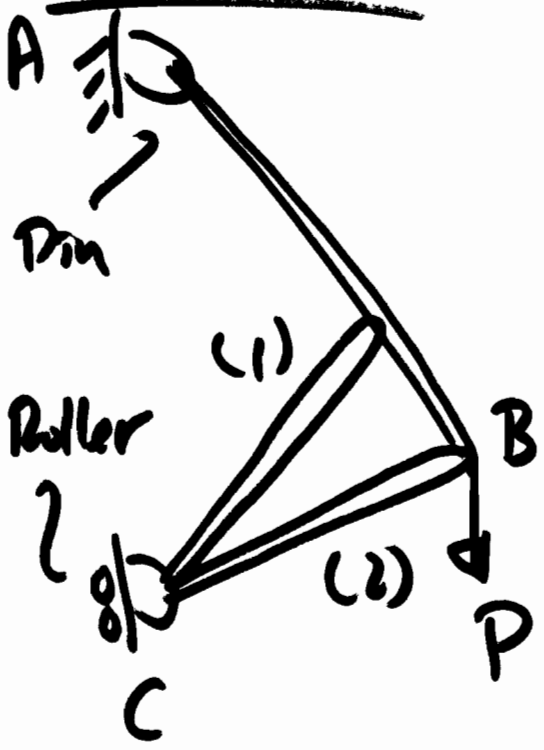


$$+\circlearrowleft \Sigma M_C = 0 \qquad -wL + F_{AB}\sin\theta \cdot a = 0$$

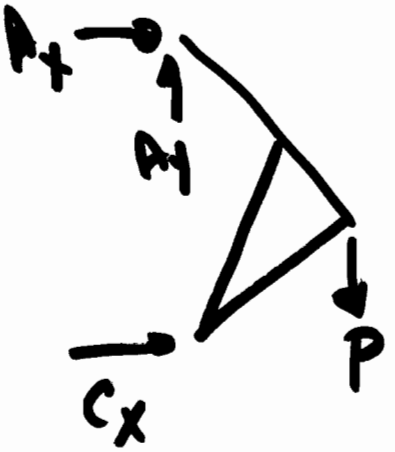
$$F_{AB} = \frac{wL}{a\sin\theta}$$

- notice that I drew a positive direction (sign convention) for summing moments
- $+\circlearrowleft \Sigma M_C$ is equal to zero since the structure is in equilibrium
- by summing moments about C, the reactions (C_x & C_y) have zero length moment arm
- only the $\sin\theta$ component of F_{AB} contributes to the moment about C
- F_{AB} was positive, indicating that we made the correct assumption about the direction of F_{AB}

STATICS HINT (1) & (2) are the 2-force members.

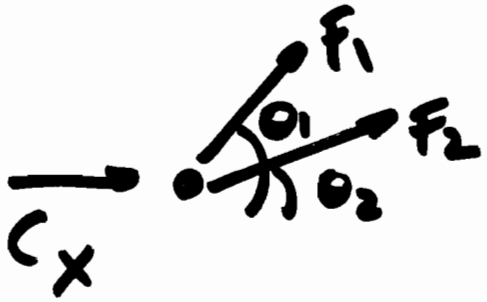


① Find RxN at Roller:



$+\circlearrowleft \sum M_A = 0$ to get C_x in terms of P

② FBD of Pin C



$\overrightarrow{+} \sum F_x = 0$

$\sum F_y \uparrow = 0$ to get two equations & two unknowns, then solve for F_1 & F_2