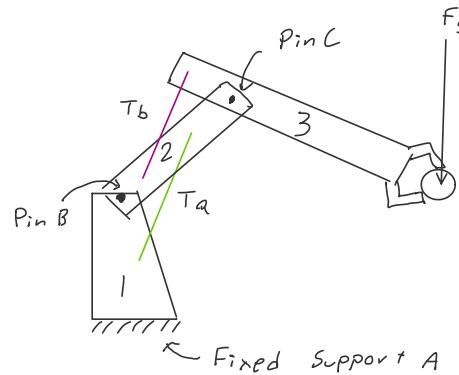


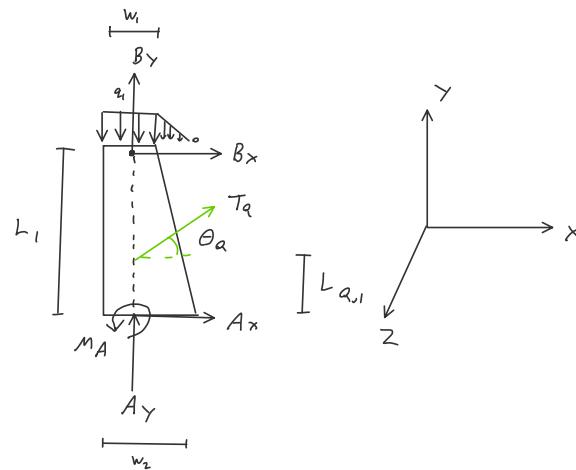
MEE 342 – Preliminary Statics Calculations

Saturday, January 31, 2026 2:24 PM

Full - Body Figure:



FBD 1



$$\sum F_{k,1} = 0 \rightarrow A_x + B_x + T_a \cos(\theta_a) = 0 \quad (1)$$

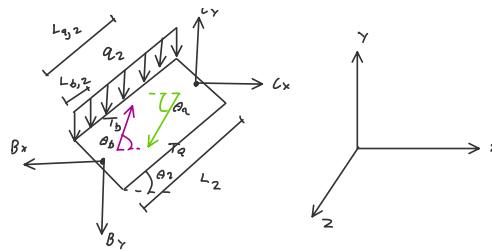
$$\sum F_{y,1} = 0 \rightarrow A_y + B_y + T_a \sin(\theta_a) - q_1 w_1 - \frac{1}{2} q_1 (w_2 - w_1) = 0$$

$$\rightarrow A_y + B_y + T_a \sin(\theta_a) = \frac{1}{2} q_1 (w_1 + w_2) \quad (2)$$

$$\sum M_A = 0 \rightarrow M_A - B_x L_1 - T_a L_{a,1} \cos(\theta_a) - \frac{1}{2} q_1 (w_2 - w_1) \left(\frac{1}{2} w_1 + \frac{w_2 - w_1}{3} \right)$$

$$\rightarrow M_A - B_x L_1 - T_a L_{a,1} \cos(\theta_a) = \frac{1}{12} q_1 (w_2 - w_1) (w_1 + 2w_2)$$

FBD 2



$$\sum F_{x,2} = 0 \rightarrow -R_x + C_x - T_a \cos(\theta_2) + T_b \cos(\theta_B) = 0 \quad (4)$$

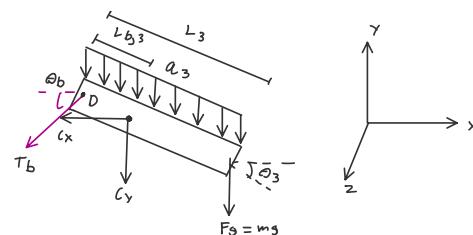
$$\sum F_{y,2} = 0 \rightarrow -R_y + C_y - T_a \sin(\theta_2) + T_b \sin(\theta_B) - q_2 L_2 = 0$$

$$\rightarrow -R_y + C_y - T_a \sin(\theta_2) + T_b \sin(\theta_B) = q_2 L_2 \quad (5)$$

$$\sum M_2 \text{ at B} = 0 \rightarrow -C_x L_2 \sin(\theta_2) + C_y L_2 \sin(90^\circ - \theta_2) - T_a L_{a,2} \sin(\theta_A - \theta_2) + T_b L_{b,2} \sin(\theta_B - \theta_2) - q_2 L_2 \left(\frac{L_2}{2} \sin(90^\circ - \theta_2) \right) = 0$$

$$\rightarrow -C_x L_2 \sin(\theta_2) + C_y L_2 \cos(\theta_2) - T_a L_{a,2} \sin(\theta_A - \theta_2) + T_b L_{b,2} \sin(\theta_B - \theta_2) = \frac{1}{2} q_2 L_2^2 \cos(\theta_2) \quad (6)$$

FBD 3



$$\sum F_{x,3} = 0 \rightarrow -C_x - T_b \cos(\theta_3) = 0$$

$$\rightarrow C_x + T_b \cos(\theta_3) = 0 \quad (7)$$

$$\sum F_{y,3} = 0 \rightarrow -C_y - T_b \sin(\theta_3) - q_3 L_3 - mg = 0$$

$$\rightarrow C_y + T_b \sin(\theta_3) = -q_3 L_3 - mg \quad (8)$$

$$\sum M_2 \text{ at D} = 0 \rightarrow C_x L_{b,3} \sin(\theta_3) - C_y L_{b,3} \sin(90^\circ - \theta_3) - q_3 L_3 \left(\frac{L_3}{2} \right) \sin(90^\circ - \theta_3) - mg L_3 \sin(90^\circ - \theta_3) = 0$$

$$\rightarrow C_x L_{b,3} \sin(\theta_3) - C_y L_{b,3} \cos(\theta_3) = \frac{1}{2} q_3 L_3^2 \cos(\theta_3) + mg L_3 \cos(\theta_3)$$

Linear System:

| A_x | A_y | M_A | B_x | B_y | C_x | C_y | T_a | T_b | |
|-------|-------|-------|---------|--------------------------|---------------------------|----------------------|--------------------------------------|-------------------------------------|--|
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | $\cos(\theta_A)$ | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | $\sin(\theta_A)$ | 0 | $\frac{1}{2} q_1 (w_1 + w_2)$ |
| 0 | 0 | 1 | - L_1 | 0 | 0 | 0 | $-L_{a,1} \cos(\theta_A)$ | 0 | $\frac{1}{2} q_1 (w_2 - w_1) (w_1 + 2w_2)$ |
| 0 | 0 | 0 | -1 | 0 | 0 | 0 | $-(\cos(\theta_B))$ | $\cos(\theta_B)$ | 0 |
| 0 | 0 | 0 | 0 | -1 | 0 | 1 | $-\sin(\theta_B)$ | $\sin(\theta_B)$ | $q_2 L_2$ |
| 0 | 0 | 0 | 0 | 0 | - $L_2 \sin(\theta_2)$ | $L_2 \cos(\theta_2)$ | $-L_{a,2} \sin(\theta_A - \theta_2)$ | $L_{b,2} \sin(\theta_B - \theta_2)$ | $\frac{1}{2} q_2 L_2^2 \cos(\theta_2)$ |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | $\cos(\theta_B)$ | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | $\sin(\theta_B)$ | $-q_3 L_3 - mg$ |
| 0 | 0 | 0 | 0 | $L_{b,3} \sin(\theta_3)$ | $-L_{b,3} \cos(\theta_3)$ | 0 | 0 | 0 | $\frac{1}{2} q_3 L_3^2 \cos(\theta_3) + mg L_3 \cos(\theta_3)$ |