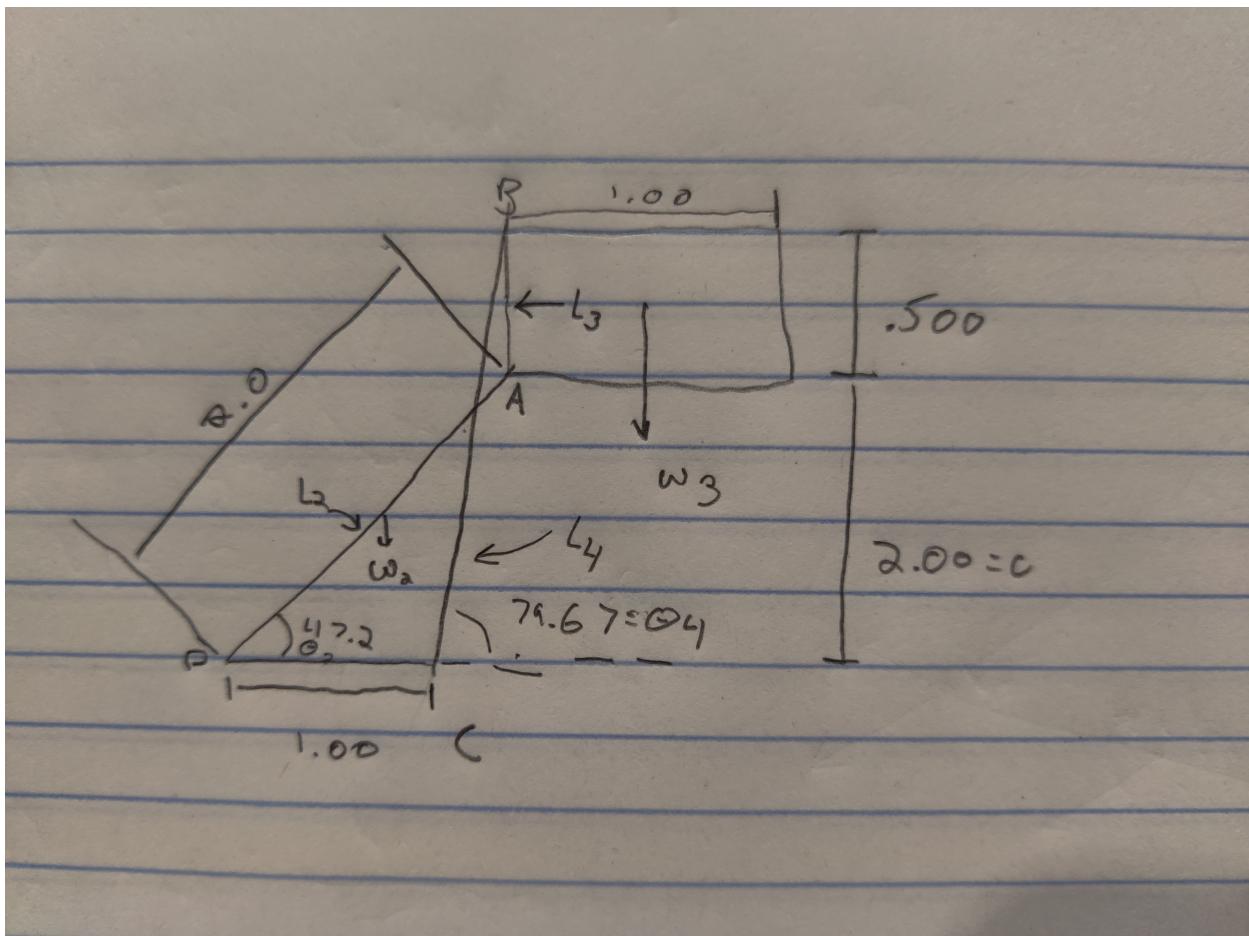


Liam Godin

RBE 2001 HW 4

1.



Known Parameters:

$$\begin{aligned} a &:= 2\text{in} & b &:= 5\text{in} & cc &:= 2\text{in} & d &:= 1\text{in} & ee &:= 1\text{in} \\ W_2 &:= 1\text{lbf} & W_3 &:= 2\text{lbf} & \text{Theta}_2 &:= 47.20\text{deg} & \text{Theta}_4 &:= 79.67\text{deg} \end{aligned}$$

Supply initial guesses for unknowns:

$$\begin{aligned} A_x &:= 2\text{lbf} & A_y &:= 2\text{lbf} & B_x &:= 2\text{lbf} & B_y &:= 2\text{lbf} \\ C_x &:= 2\text{lbf} & C_y &:= 2\text{lbf} & D_x &:= 2\text{lbf} & D_y &:= 2\text{lbf} \\ M_2 &:= 4\text{in.lbf} \end{aligned}$$

From equations of equilibrium we have nine equations with nine unknowns:

Given

From FBE of  $L_2$ ,  $L_3$ , and  $L_4$  as a system:

$$0 = M_2 - D_y \cdot d - W_3 \left( cc \cdot \cos(\text{Theta}_4) + \frac{ee}{2} \right) + W_2 \left( d - \cos(\text{Theta}_2) \frac{a}{2} \right) \quad \Sigma M_C := 0$$

$$0 = C_x + D_x \quad \Sigma F_x := 0$$

$$0 = C_y + D_y - W_2 - W_3 \quad \Sigma F_y := 0$$

From FBE of  $L_2$ :

$$0 = -B_x \cdot b - W_3 \cdot \frac{ee}{2} \quad \Sigma F_A := 0$$

$$0 = A_x + B_x \quad \Sigma F_{Ax} := 0$$

$$0 = A_y + B_y - W_3 \quad \Sigma F_{Ay} := 0$$

From FBE of  $L_2$ :

$$0 = A_x \cdot a \cdot \sin(\text{Theta}_2) - A_y \cdot a \cdot \cos(\text{Theta}_2) - W_2 \left( \cos(\text{Theta}_2) \frac{a}{2} \right) \quad \Sigma M_B := 0$$

$$0 = D_x - A_x \quad \Sigma F_{Ax} := 0$$

$$0 = D_y - A_y - W_2 \quad \Sigma F_{Ay} := 0$$

$$\begin{pmatrix} SA_x \\ SA_y \\ SB_x \\ SB_y \\ SC_x \\ SC_y \\ SD_x \\ SD_y \\ SM_2 \end{pmatrix} := \text{Find}(A_x, A_y, B_x, B_y, C_x, C_y, D_x, D_y, M_2)$$

$$SA_x = 2\text{lbf}$$

$$SA_y = 1.66\text{lbf}$$

$$SB_x = -2\text{lbf}$$

$$SB_y = 0.34\text{lbf}$$

$$SC_x = -2\text{lbf}$$

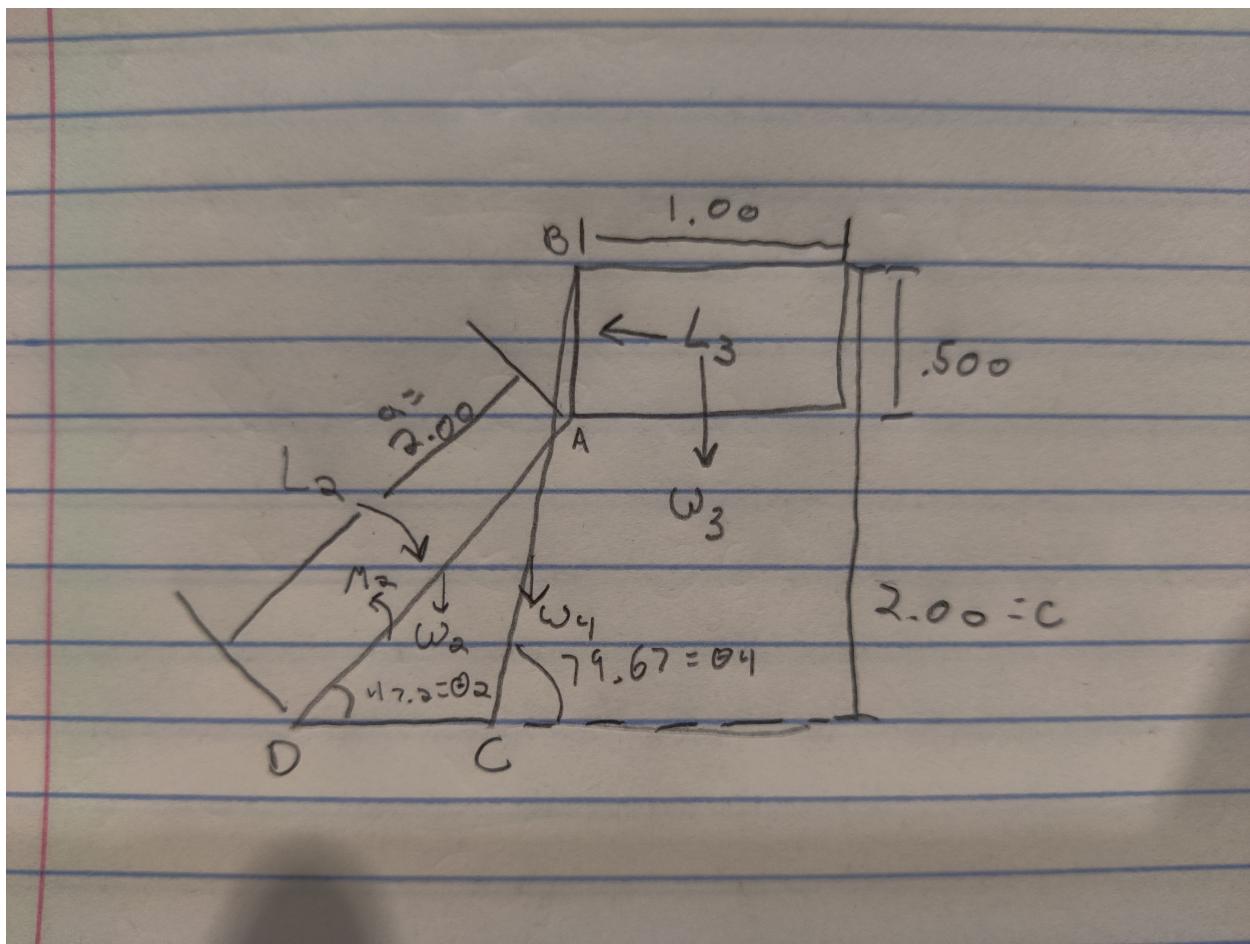
$$SC_y = 0.34\text{lbf}$$

$$SD_x = 2\text{lbf}$$

$$SD_y = 2.66\text{lbf}$$

$$SM_2 = 4.06\text{in.lbf}$$

2.



Known Parameters:

$$\begin{aligned} a &:= 2\text{in} & b &:= .5\text{in} & cc &:= 2\text{in} & d &:= 1\text{in} & ee &:= 1\text{in} \\ W_2 &:= 1\text{lbf} & W_3 &:= 2\text{lbf} & \text{Theta}_2 &:= 47.20\text{deg} & \text{Theta}_4 &:= 79.67\text{deg} & W_4 &:= 10\text{lbf} \end{aligned}$$

Supply initial guesses for unknowns:

$$\begin{aligned} A_x &:= 2\text{lbf} & A_y &:= 2\text{lbf} & B_x &:= 2\text{lbf} & B_y &:= 2\text{lbf} \\ C_x &:= 2\text{lbf} & C_y &:= 2\text{lbf} & D_x &:= 2\text{lbf} & D_y &:= 2\text{lbf} \\ M_2 &:= 4\text{in}\cdot\text{lbf} \end{aligned}$$

From equations of equilibrium we have nine equations with nine unknowns:

Given

From FBE of L<sub>2</sub>, L<sub>3</sub>, and L<sub>4</sub> as a system:

$$0 = M_2 + C_y \cdot d - W_3 \left( d + cc \cdot \cos(\text{Theta}_4) + \frac{ee}{2} \right) - W_2 \frac{a}{2} \cdot \cos(\text{Theta}_2) - W_4 \left( d + \frac{cc \cdot \cos(\text{Theta}_4)}{2} \right)$$

$$0 = C_x + D_x$$

$$\Sigma R_x := 0$$

$$\Sigma M_D := 0$$

$$0 = C_y + D_y - W_2 - W_3 - W_4$$

$$\Sigma R_y := 0$$

From FBE of L<sub>2</sub>:

$$0 = -B_x \cdot b - W_3 \frac{ee}{2}$$

$$\Sigma M_A := 0$$

$$0 = A_x + B_x$$

$$\Sigma R_x := 0$$

$$0 = A_y + B_y - W_3$$

$$\Sigma R_y := 0$$

From FBE of L<sub>3</sub>:

$$0 = B_x \cdot cc \cdot \sin(\text{Theta}_4) - B_y \cdot cc \cdot \cos(\text{Theta}_4) - W_4 \cdot \frac{cc \cdot \cos(\text{Theta}_4)}{2}$$

$$\Sigma M_C := 0$$

$$0 = C_x - B_x$$

$$\Sigma R_x := 0$$

$$0 = C_y - B_y - W_4$$

$$\Sigma R_y := 0$$

$$\begin{pmatrix} SA_x \\ SA_y \\ SB_x \\ SB_y \\ SC_x \\ SC_y \\ SD_x \\ SD_y \\ SM_2 \end{pmatrix} := \text{Find}(A_x, A_y, B_x, B_y, C_x, C_y, D_x, D_y, M_2)$$

$$SA_x = 2\text{lbf}$$

$$SA_y = 17.97\text{lbf}$$

$$SB_x = -2\text{lbf}$$

$$SB_y = -15.97\text{lbf}$$

$$SC_x = -2\text{lbf}$$

$$SC_y = -5.97\text{lbf}$$

$$SD_x = 2\text{lbf}$$

$$SD_y = 18.97\text{lbf}$$

$$SM_2 = 22.16\text{in}\cdot\text{lbf}$$