Plane Frames   2-D Frames

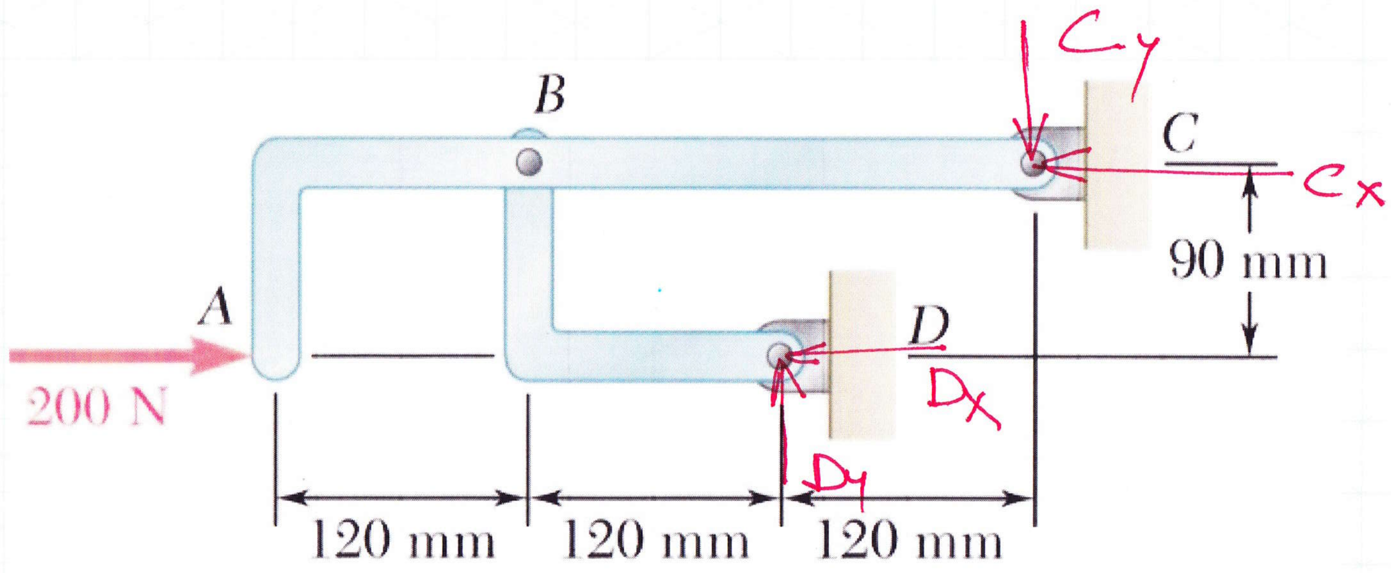
1) a collection of members that are connected with frictionless pins.

2) at least one member of the frame is not a 2-Force member – multiforce member.

3) loads can be applied at any point.

Brute Force Method for Frames

1. Draw FBD's of all individual members
2. Show all external forces and interconnecting forces — being careful to maintain compatibility between all FBD's
3. Write scalar equations of equilibrium for each member. $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M_z = 0$
4. Solve the equations using the method of your choice. EES

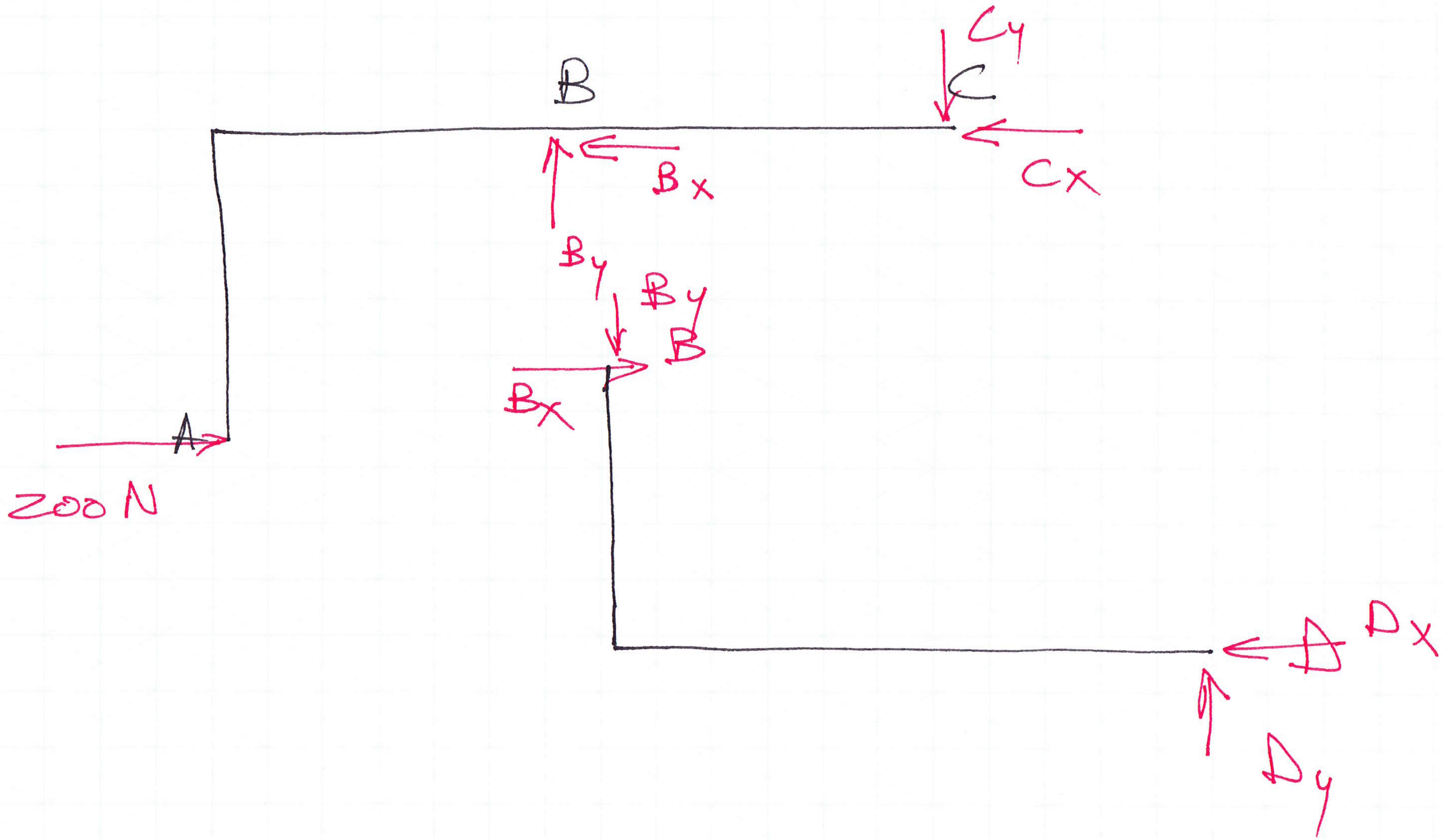


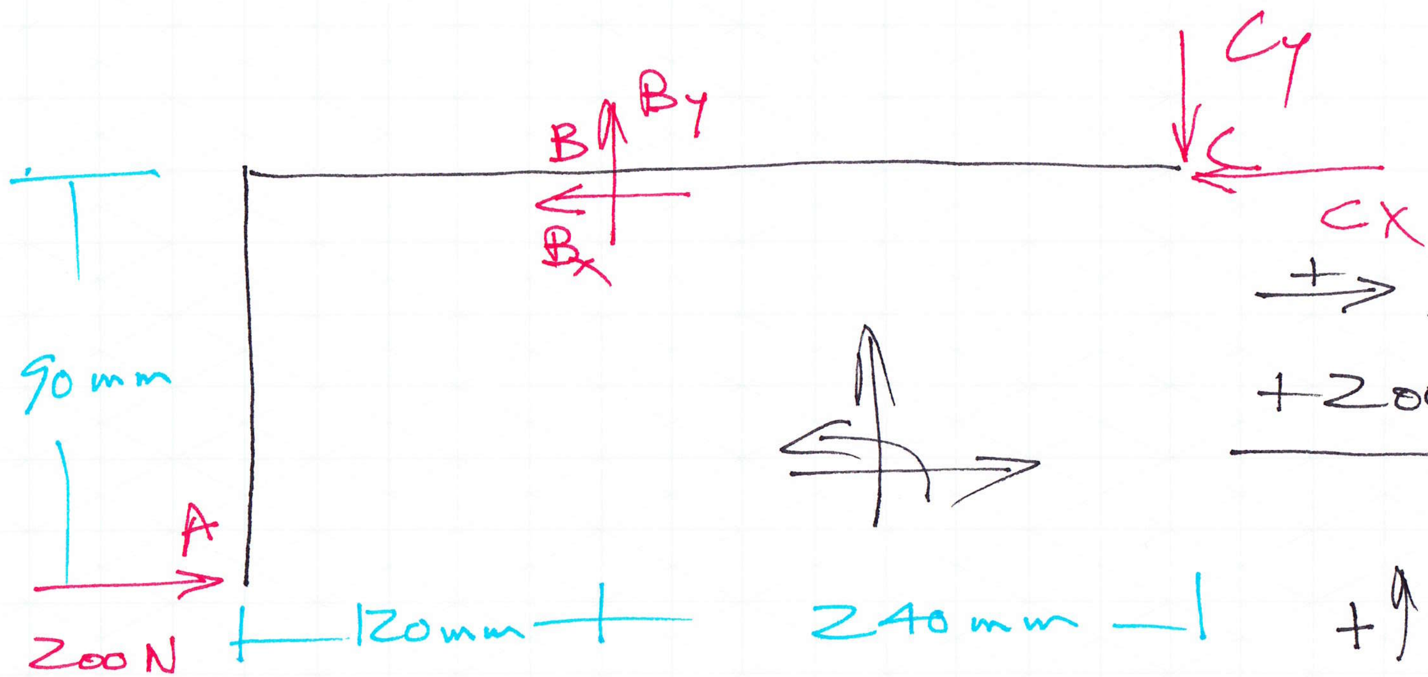
Cx, Cy, Dx, Dy
External Reactions

Bx, By internal pin forces

Unknowns		Knowns
6	=	6

This has a chance to be determinate.


B
C
Cy
Bx
Cx
By
By
B
Bx
A
200 N
D
Dx
Dy



$\overset{+}{\rightarrow} \sum F_x = 0$

$+200 - B_x - C_x = 0$ (1)

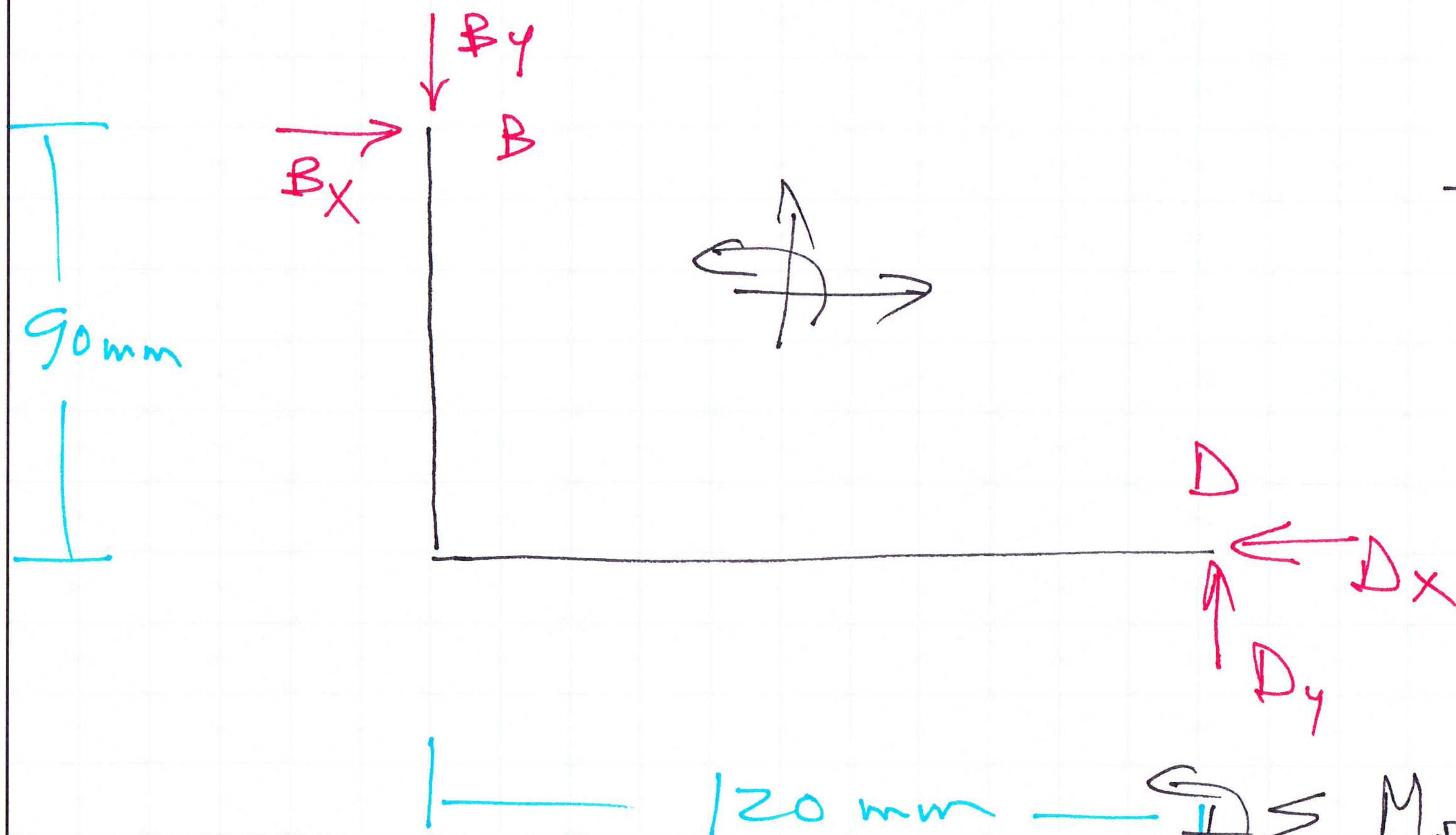
$+\uparrow \sum F_y = 0$

$+B_y - C_y = 0$ (2)

$\circlearrowleft + \sum M_C = 0$

$200(90) - B_y(240) = 0$

$B_y = 75$ (3)



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

$B_x - D_x = 0 \qquad (4)$

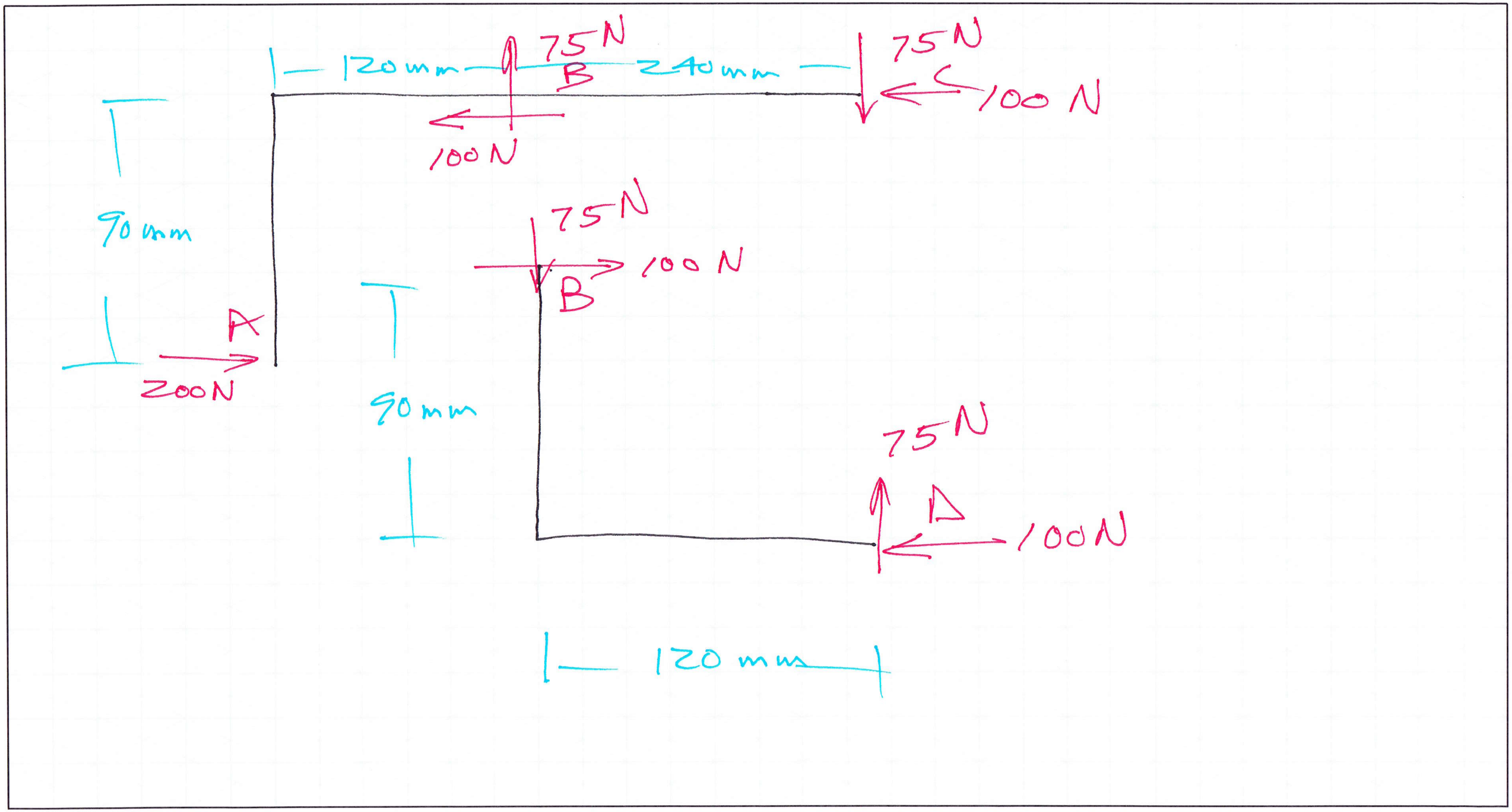
$+\uparrow \sum F_y = 0$

$-B_y + D_y = 0 \qquad (5)$

$\circlearrowleft + \sum M_B = 0$

$+D_y(120) - D_x(90) = 0 \qquad (6)$

Solve Simultaneously EES


120 mm
75 N
B
240 mm
75 N
100 N
100 N
90 mm
A
200 N
75 N
100 N
B
90 mm
75 N
D
100 N
120 mm

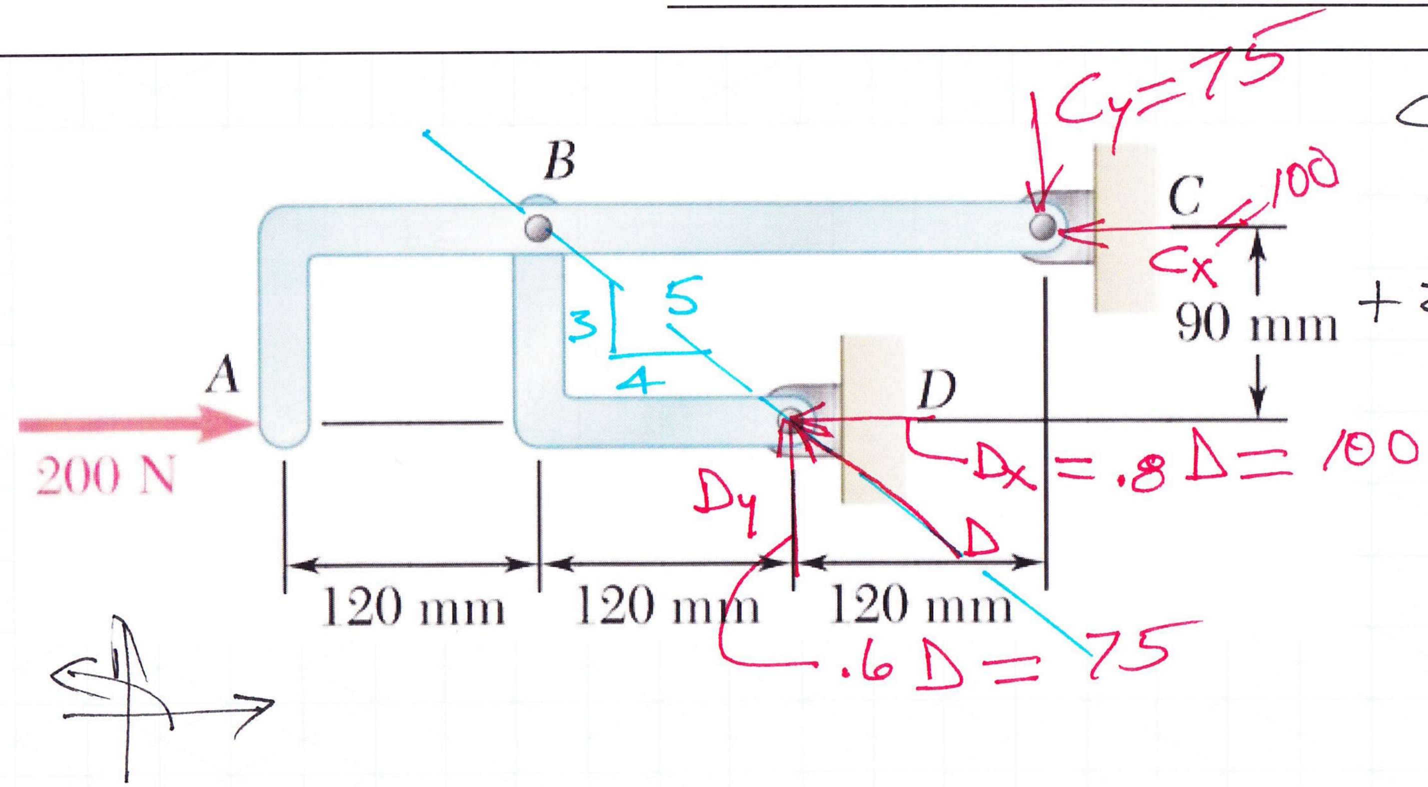
Intuitive Method

Examine the Problem carefully.

2 – Force Members

internal hinge

Structure a solution that yields results as you move forward



$\circlearrowleft + \Sigma M_C = 0$

$+200(90) - .6D(120) - .8D(90) = 0$

$144D = 18000$

$D = 125\ N$

$D_x = (.8)(125) = 100\ N$

$D_y = (.6)(125) = 75\ N$

$\overset{+}{\rightarrow} \Sigma F_x = 0$

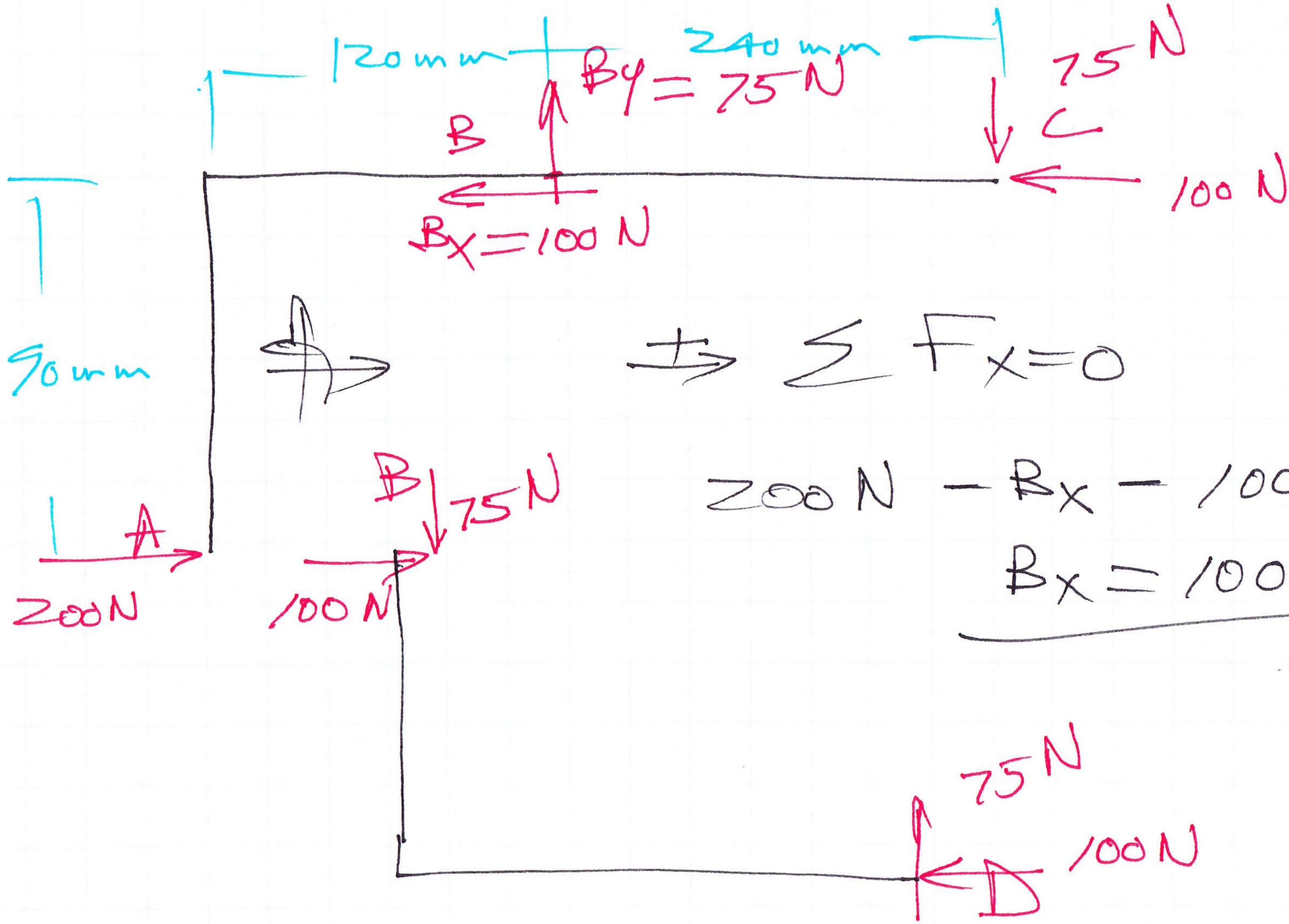
$200 - C_x - 100 = 0$

$C_x = 100\ N$

$+\uparrow \Sigma F_y = 0$

$+75 - C_y = 0$

$C_y = 75\ N$



$\uparrow \sum F_y = 0$

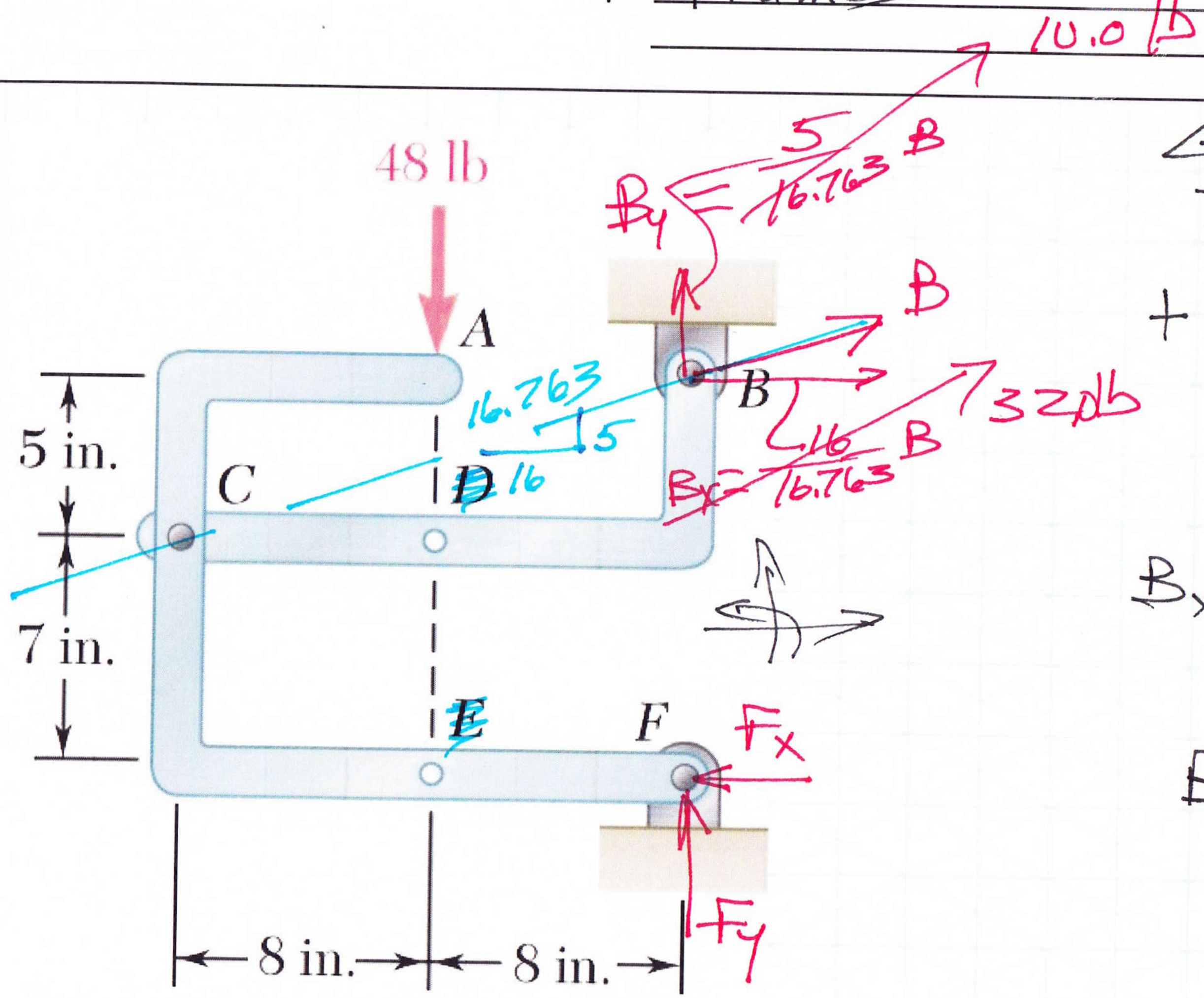
$B_y - 75 = 0$

$B_y = 75\ N$ as shown

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

$200\ N - B_x - 100\ N = 0$

$B_x = 100\ N$ as shown



$\circlearrowleft + \sum M_F = 0$

$+(48)(8) - \frac{16}{16.763} B (12) = 0$

$B = 33.526 \text{ lb}$

$B_x = \frac{16}{16.763}(33.526) = 32.0 \text{ lb}$ as shown

$B_y = \frac{5}{16.763}(33.526) = 10.0 \text{ lb}$ as shown

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

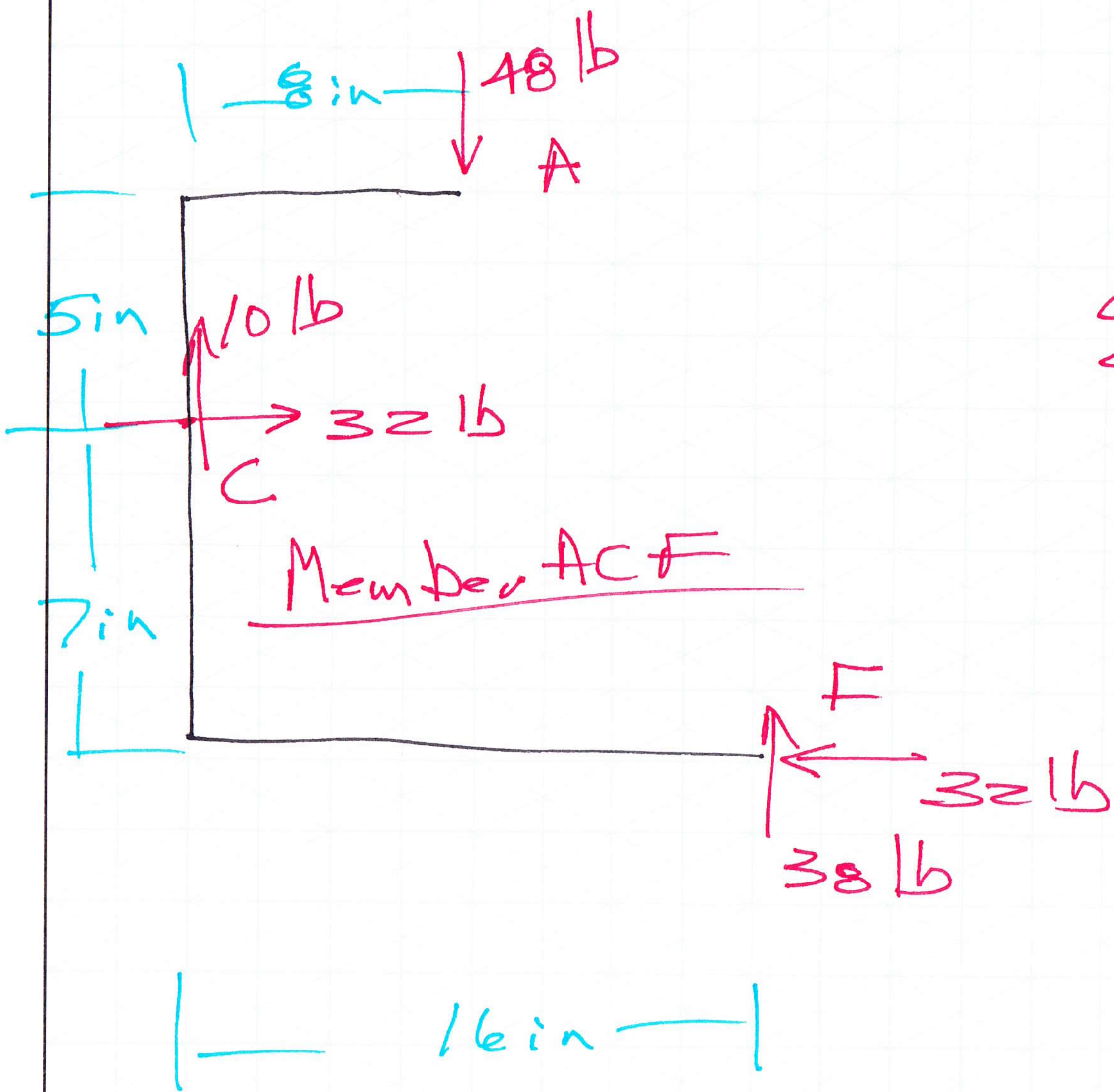
$32 - F_x = 0$

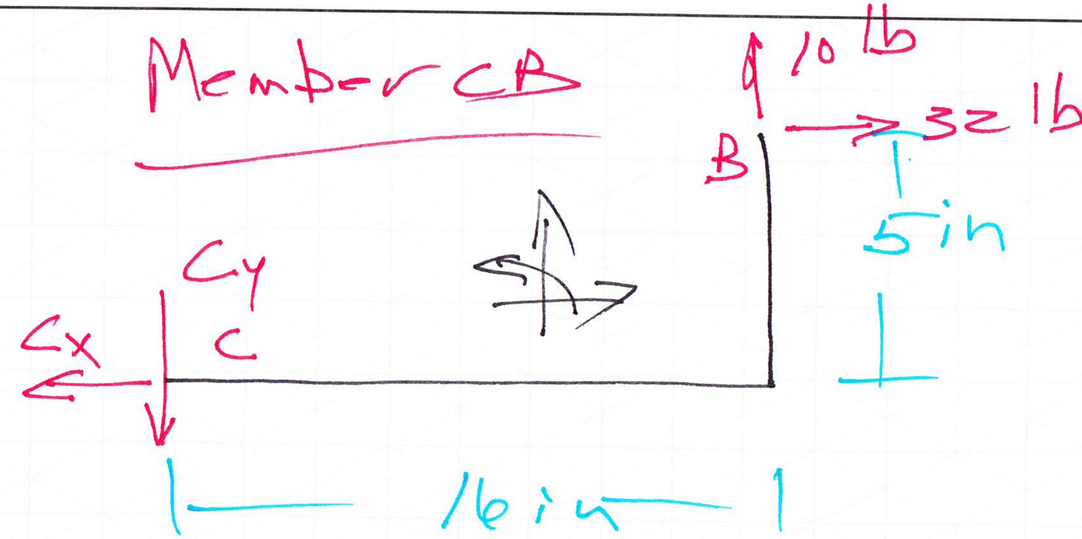
$F_x = 32 \text{ lb} \leftarrow$ as shown

$+\uparrow \sum F_y = 0$

$-48 + 10 + F_y = 0$

$F_y = 38 \text{ lb} \uparrow$ as shown





$\xrightarrow{+} \Sigma F_x = 0$

$-C_x + 32 = 0$

$C_x = 32 \text{ lb}$ ← as shown

$+\uparrow \Sigma F_y = 0$

$-C_y + 10 = 0$

$C_y = 10 \text{ lb}$ ↓ as shown