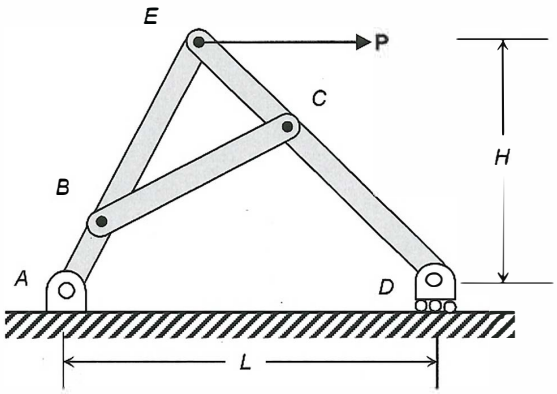
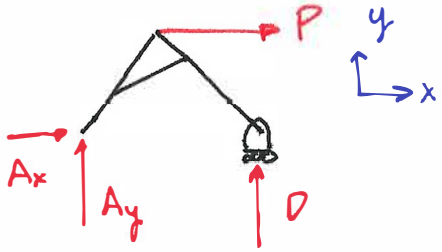
Example

Consider the structure below. All members can be considered massless. Set up the equations necessary to find the reactions at A and D.





$\Sigma F_x = 0$

$P + A_x = 0$

$A_x = -P \quad (1)$

$\Sigma F_y = 0$

$A_y + D = 0$

$A_y = -D \quad (2)$

$\Sigma M_A = 0$

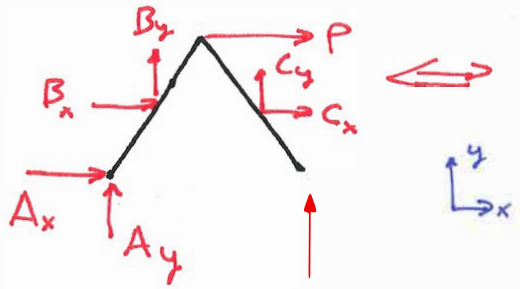
$-HP + LD = 0$

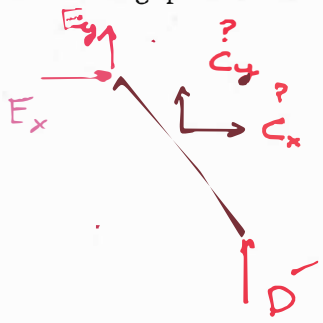
$D = \frac{HP}{L} \quad (3)$

NOW REACTIONS @ A & D ARE KNOWN.

Example

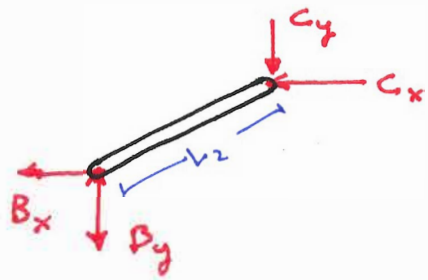
Find the reactions at pins B and C in the last example. Is there anything special about those reactions?



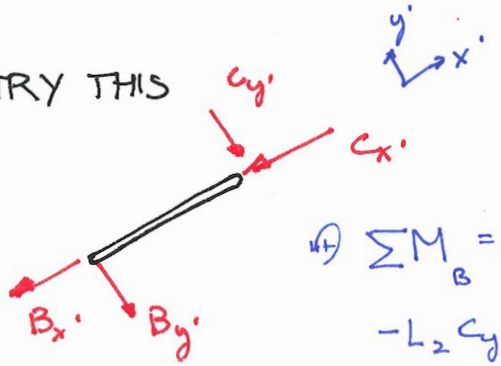


4 UNKNOWNS
BUT ONLY 3 EQUATIONS

LOOK @ FBD of BC



TRY THIS



$\curvearrowleft \sum M_B = 0$

$-L_2 C_{y'} = 0$

$C_{y'} = 0$

$\sum F_{y'} = 0$

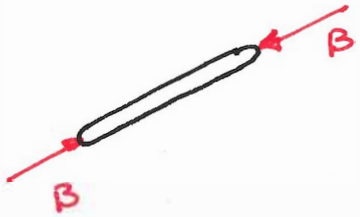
$-\cancel{C_{y'}} + -B_{y'} = 0$

$B_{y'} = 0$

$\sum F_{x'} = 0$

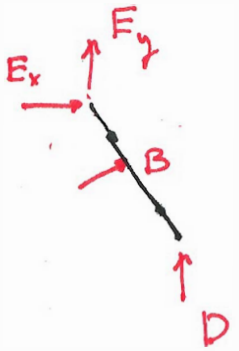
$-B_{x'} - C_{x'} = 0 \qquad B_{x'} = -C_{x'}$

RESULT



TWO FORCE MEMBER

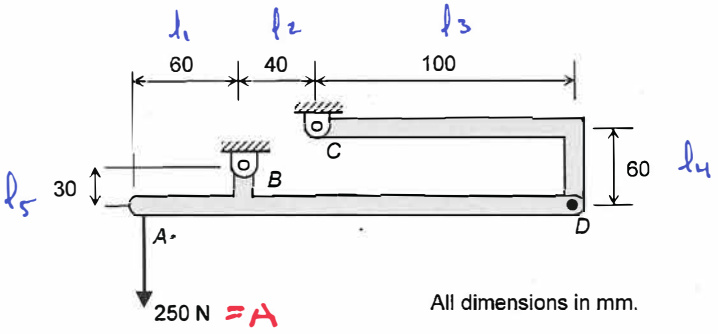
- REACTIONS ARE COLLINEAR
- " " OPPOSITELY DIRECTED
- MAKES LIFE EASIER!



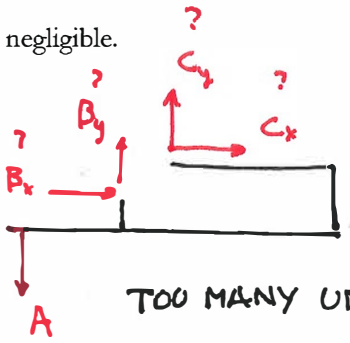
. . .

Example

Find the reactions at B and C. Assume that the weight of the structure is negligible.

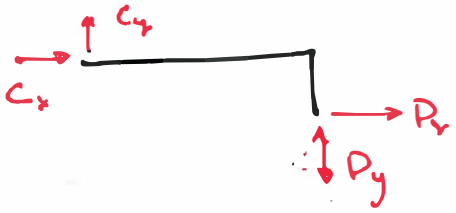


All dimensions in mm.

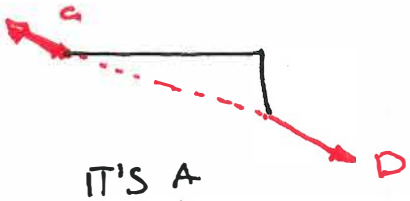


TOO MANY UNKNOWNS (4)

TRY CD FBD

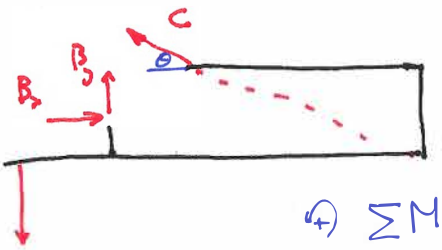


$\Leftrightarrow$



IT'S A 2-FORCE MEMBER!

NEW FBD of ABC:



$\theta = \tan^{-1}\left(\frac{60}{100}\right) =$ ____

$\circlearrowleft + \sum M_B = 0$

$l_2 C \sin\theta + (l_4 - l_5) C \cos\theta + l_1 A = 0 \quad (1)$

$C = \frac{-l_1 A}{\quad}$

$\sum F_x = 0$

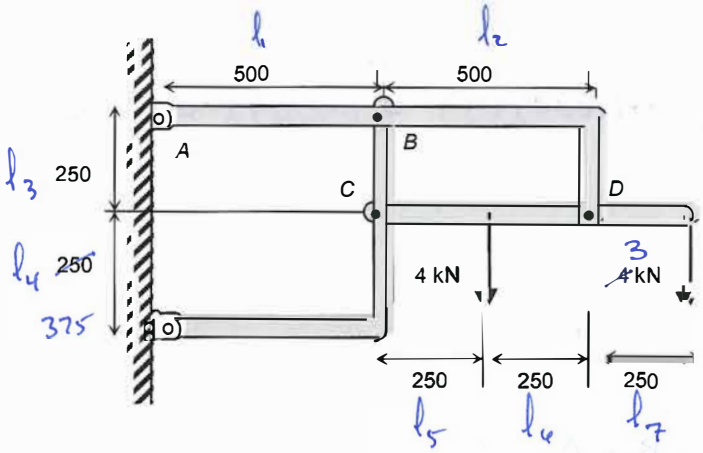
$B_x - C\cos\theta = 0 \quad (2)$

$\sum F_y = 0$

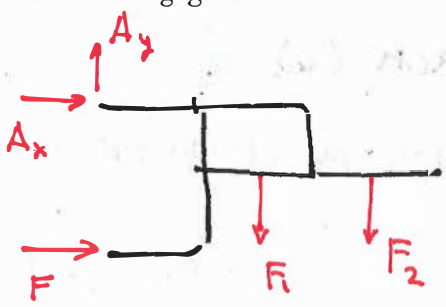
$-A + B_y + C\sin\theta = 0 \quad (3)$

Example

Find the components of all forces. *ABD*. Assume that the weight of the structure is negligible.



All dimensions in mm.



$\sum F_x = 0$

$A_x + F = 0 \quad A_x = -F \quad (1)$

$\sum F_y = 0$

$A_y - F_1 - F_2 = 0 \quad A_y = F_1 + F_2$

$= 7\ kN \quad (2)$

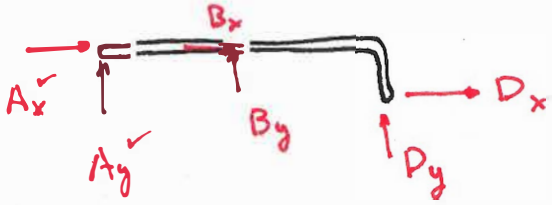
$\sum M_A = 0$

$(l_3 + l_4)F - (l_1 + l_5)F_1 - (l_1 + l_5 + l_6 + l_7)F_2 = 0 \quad (3)$

$(625) \quad (750)\ (4) \quad (1250)\ (3)$

$\therefore F = 10.8\ kN \Rightarrow$ FROM (1) $A_x = -10.8\ kN$

ABD ONLY



4 UNKNOWNS

3 EQUATIONS

$\sum F_x = 0$

$A_x + B_x + D_x = 0 \quad (4)$

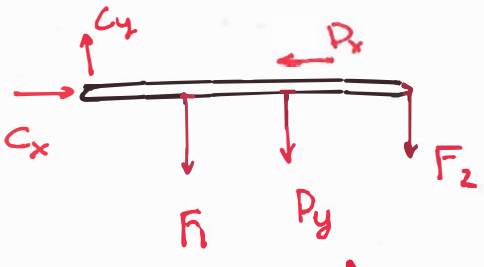
$\sum F_y = 0$

$A_y + B_y + D_y = 0 \quad (5)$

$\sum M_D$

$-l_3 A_x - l_3 B_x - (l_1 + l_2) A_y - (l_2) B_y = 0 \quad (6)$

NEED ANOTHER FBD:



NOTE DIRECTION

CAN YOU FIND AN EQUATION TO REDUCE YOUR EFFORT?

$\sum M_C = 0$

$-l_5 F_1 - (l_5 + l_6) D_y - (l_5 + l_6 + l_7) F_2 = 0$

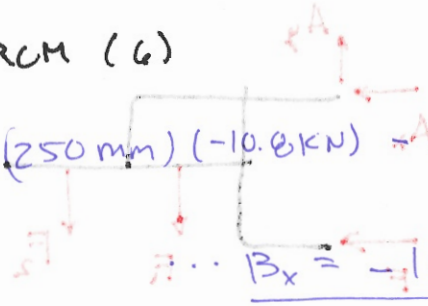
$(250)\ (4)\ (500)\ (250)$

$D_y = -6.5\ kN$

FROM (5)

$$B_y = -A_y - D_y = -7\,kN - (-6.5\,kN) = \underline{-0.5\,kN}$$

FROM (6)



$$-(250\,mm)(-10.8\,kN) + (250)B_x - (1000)(7) - (500)(-0.5) = 0$$

$$\therefore B_x = \underline{-16.2\,kN}$$

FROM (4)

~~$B_x = -A_x - D_x$~~

~~$= -(-10.8\,kN)$~~

$$D_x = -B_x - A_x$$

$$= -(-16.2) - (-10.8)\,kN$$

$$= \underline{27\,kN}$$