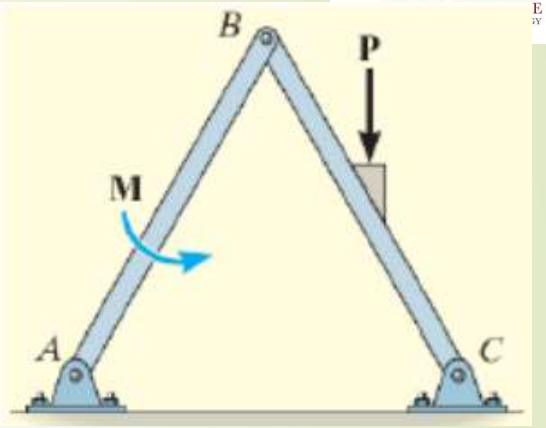
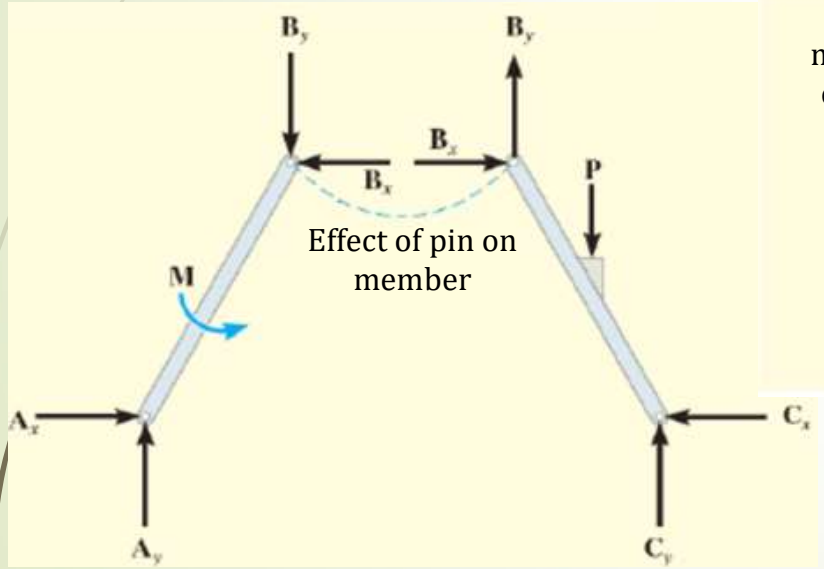
Example: Draw FBD of

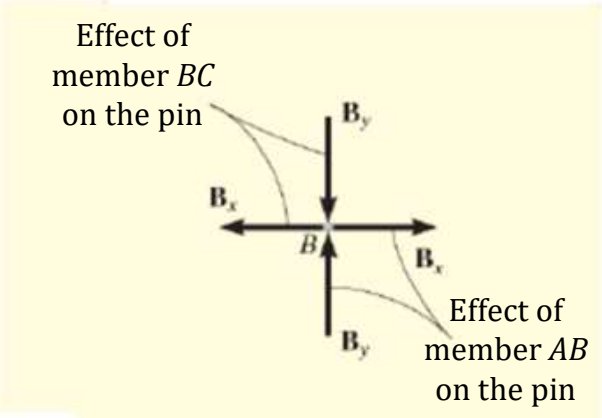
(i) Whole system

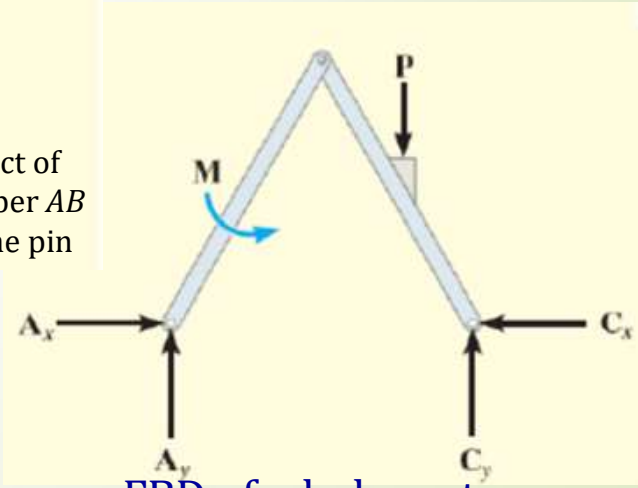
(ii) Each member separately, and

(iii) Pin at B



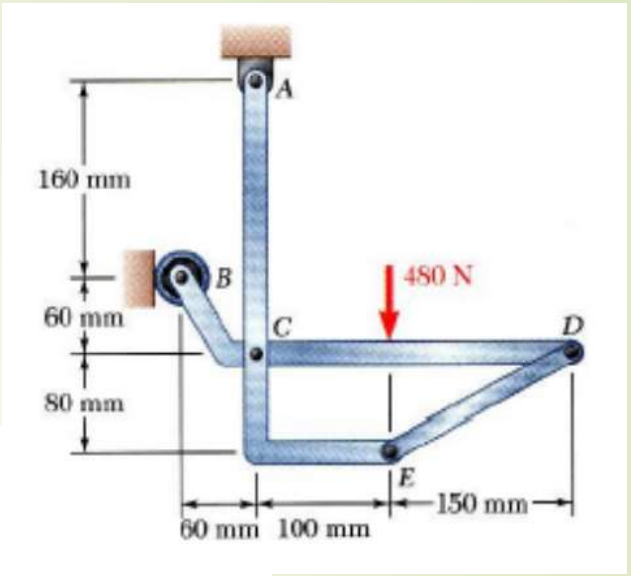






FBD of whole system

Example: Members *ACE* and *BCD* are connected by a pin at *C* and by the link *DE*. For the loading shown, determine the force in the link *DE* and the components of the force exerted at *C* on member *BCD*.



Solution:

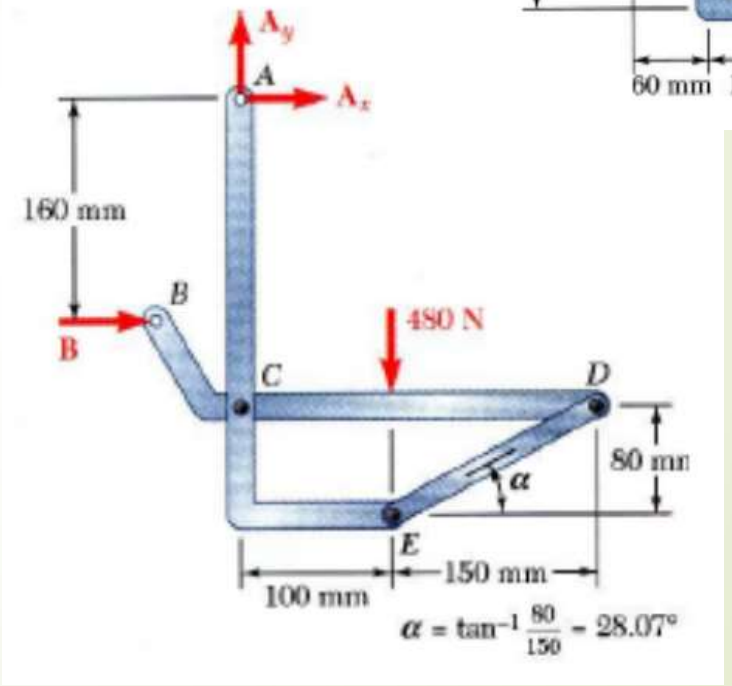
1. Create a free-body diagram for the complete frame and solve for the support reactions.

$\Sigma F_y = 0; \quad A_y - 480 = 0; \quad A_y = 480N;$

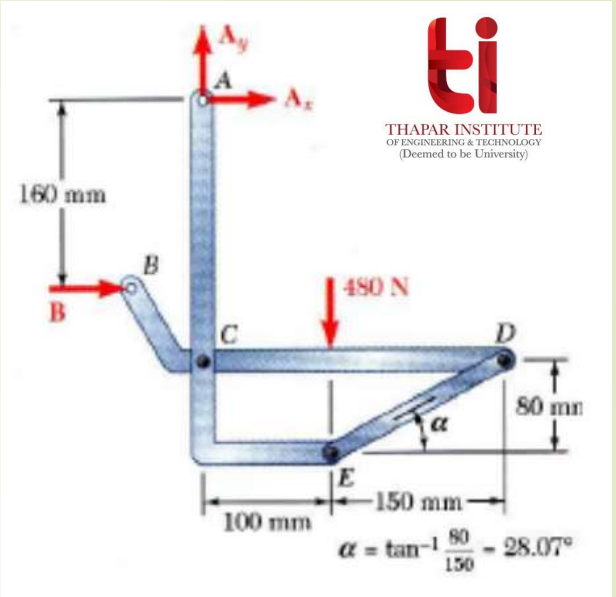
$\Sigma M_A = 0; \quad B \times 160 - 480 \times 100 = 0;$

$B = 300\ N;$

$\Sigma F_x = 0; \quad A_x + B = 0; \quad A_x = -300\ N;$



2. Draw a free-body diagram for the member *BCD*. The force exerted by the link *DE* has a known line of action but unknown magnitude. It is determined by summing moments about *C*.



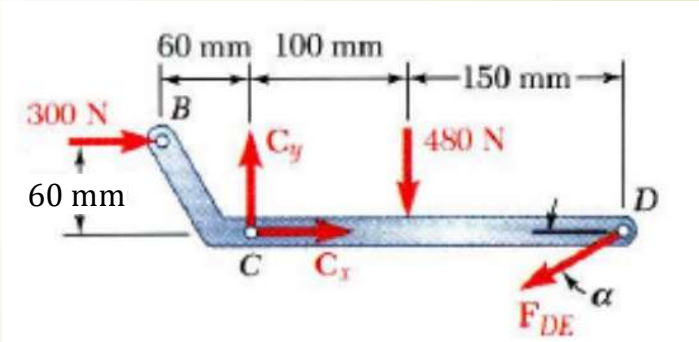
$\Sigma M_C = 0;$

$(300 \times 60) + (480 \times 100) + F_{DE} \sin\alpha \times 250 = 0;$

$\tan\alpha = \frac{80}{150} \rightarrow \alpha = 28.07°;$ $F_{DE} = -561\ N$

$\Sigma F_y = 0;$ $C_y - 480 - F_{DE} \sin\alpha = 0;$

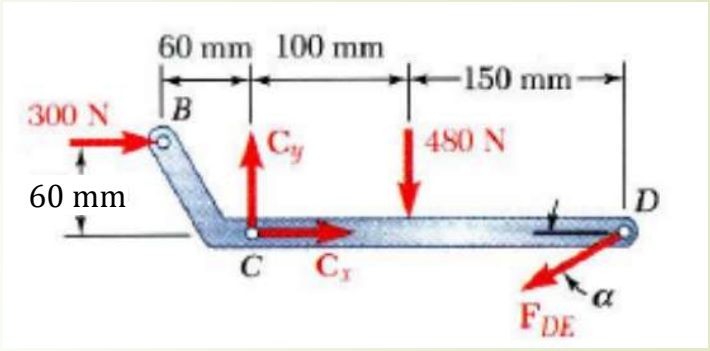
$C_y = 480 + (-561 \sin 28.07°);$ $C_y = 216\ N$



$\Sigma F_x = 0;$ $300 + C_x - F_{DE} \cos\alpha = 0;$

$C_x = -300 + (-561 \cos 28.07°);$ $C_x = -795\ N$

3. With member ACE as a free-body, check the solution by summing moments about A.

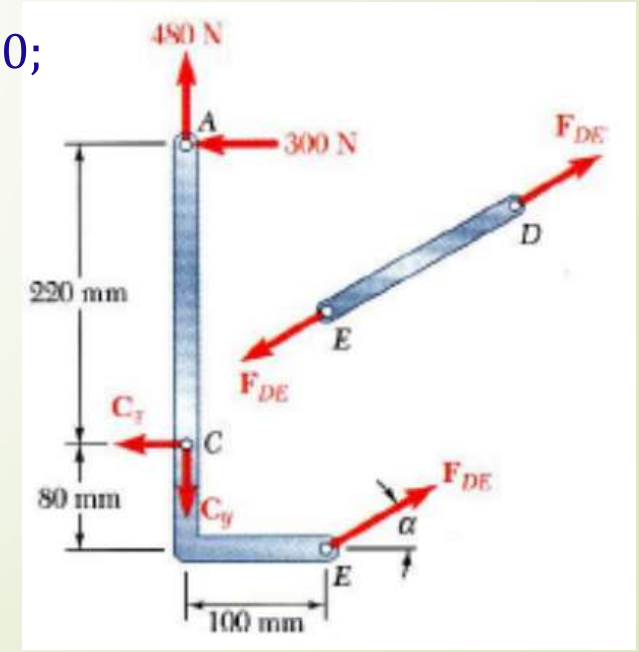


$\Sigma M_A = 0;$

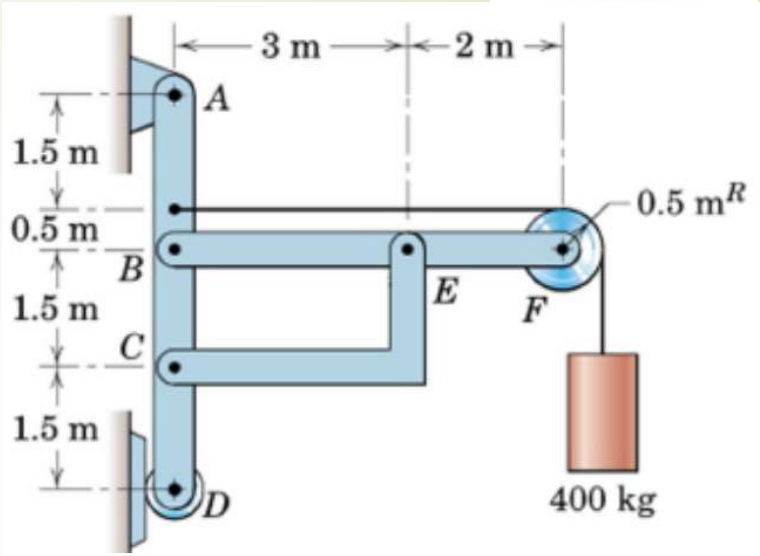
$(C_x \times 220) - (F_{DE} \sin\alpha \times 100) - (F_{DE} \cos\alpha \times 300) = 0;$

$(C_x \times 220) = (-561 \sin 28.07 \times 100) + (-561 \cos 28.07 \times 300) = 0;$

$C_x = -795\ N$ (Check)



Example: Compute the horizontal and vertical components of all the forces acting on each of the members (neglect self weight).



Solution: Draw FBD of the whole frame

$$\Sigma M_A = 0;$$

$$(400 \times 9.81 \times 10^{-3}) \times 5.5 - 5D = 0; \quad \rightarrow \quad D = 4.32\ kN$$

$$\Sigma F_x = 0;$$

$$A_x - 4.32 = 0; \quad \rightarrow \quad A_x = 4.32\ kN$$

$$\Sigma F_y = 0;$$

$$A_y - 3.92 = 0; \quad \rightarrow \quad A_y = 3.92\ kN$$