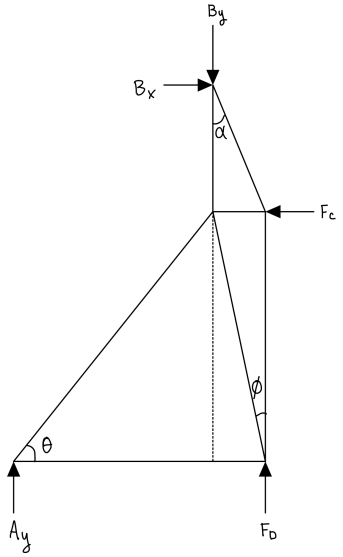
21-S-6-ZA-56 Solution

Question: The system shown is acted on by two forces, $F_C\ N$ and $F_D\ N$ and is supported by a roller at point A and pin at point B. Find the magnitude of force in members CE and DE if $a\ m$, $b\ m$, $c\ m$, and $d\ m$

Solution:



We start by finding the angles in the truss, and the reaction forces.

$\theta = arctan(b/(a - d))$, $\phi = arctan(d/b)$, $\alpha = arctan(d/c)$

$\Sigma F_x = B_x - F_C = 0 \Rightarrow B_x = F_C$

$\Sigma M_B = -F_C c + F_D d - A_y(a - d) = 0 \Rightarrow A_y = (F_D d - F_C c)/(a - d)$

$\Sigma F_y = -B_y + A_y + F_D = 0 \Rightarrow B_y = A_y + F_D$

Then, we find the forces in each member using the method of joints.

Joint A:

$\Sigma F_y = A_y - F_{AE} sin\theta = 0 \Rightarrow F_{AE} = A_y/sin\theta$

$\Sigma F_x = F_{AD} - F_{AE} cos\theta = 0 \Rightarrow F_{AD} = F_{AE} cos\theta$

Joint B:

$\Sigma F_x = B_x - F_{CB} sin\alpha = 0 \Rightarrow F_{CB} = B_x/sin\alpha$

$\Sigma F_y = -B_y + F_{CB} cos\alpha + F_{BE} = 0 \Rightarrow F_{BE} = B_y - F_{CB} cos\alpha$

Joint D:

$\Sigma F_x = -F_{AD} + F_{ED} sin\phi = 0 \Rightarrow F_{ED} = F_{AD}/sin\phi$

$\Sigma F_y = F_D - F_{ED} cos\phi - F_{CD} = 0 \Rightarrow F_{CD} = F_D - F_{ED} cos\phi$

Joint C:

$\Sigma F_x = F_{CB} cos(90 - \alpha) - F_C + F_{CE} = 0 \Rightarrow F_{CE} = F_C - F_{CB} cos(90 - \alpha)$