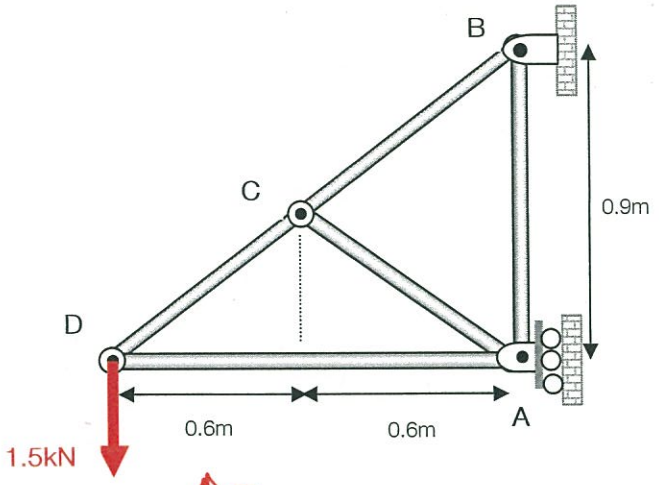
RMIT UNIVERSITY

WORKED SOLUTIONS

ENST2.1: METHOD OF JOINTS

Question

Determine the reactions, and the force in each member of the truss using the method of joints. State if the members are in tension (T) or compression (C). (Hibbeler, R.C, 1992, *Statics*, Pearson)

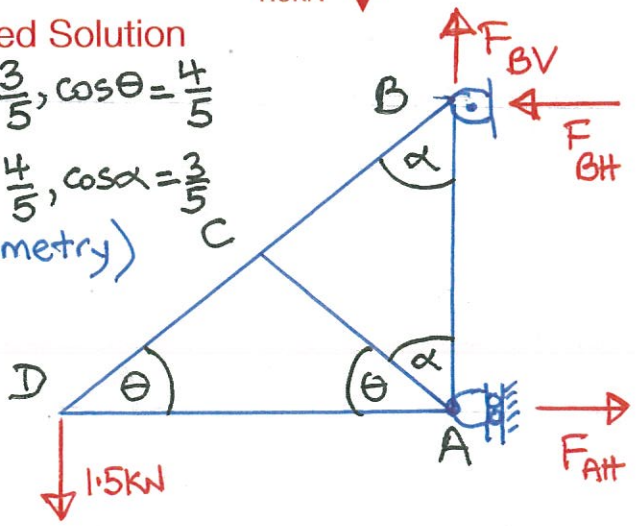


Worked Solution

$\sin\theta = \frac{3}{5}, \cos\theta = \frac{4}{5}$

$\sin\alpha = \frac{4}{5}, \cos\alpha = \frac{3}{5}$

(geometry)



Supports

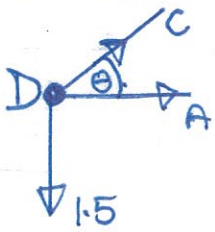
Pinned joint at B will have x and y components: F_{BH} and F_{BV}

Roller joint at A will have only an x component: F_{AH}

- Calculate Support forces (reactions) first
- $+\uparrow \Sigma F_Y = 0$: $F_{BV} - 1.5 = 0 \Rightarrow F_{BV} = 1.5\,KN$ (up)
- $+\circlearrowright \Sigma M_D = 0$: Joint D used as it has fewest unknown forces
  $(-F_{BH} \times 0.9) + (-F_{BV} \times 1.2) = 0 \Rightarrow F_{BH} = -2KN$ (to right)
- $\pm\rightarrow \Sigma F_X = 0$: $2 + F_{AH} = 0 \Rightarrow F_{AH} = -2KN$ (to left)

- Calculate forces in members at joints next
- Assume members are in tension (T)
- Choose joint with fewest unknown forces
- Choose joint where members are perpendicular to each other

Joint D



- $+\uparrow \Sigma F_Y = 0$: $F_{DC}\sin\theta - 1.5 = 0 \Rightarrow F_{DC} = {}^{+}2.5$ KN (T)

Note: F_{DC} is +, ∴ assumed direction correct

$\sin\theta = 3/5$

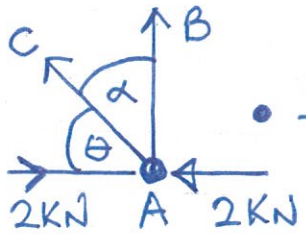
- $\pm\rightarrow \Sigma F_X = 0$: $F_{DC}\cos\theta + F_{DA} = 0 \Rightarrow F_{DA} = {}^{-}2$KN (C)

Note: F_{DA} is −, ∴ assumed direction incorrect

$\cos\theta = 4/5$ ie, compression (C)

Joint A

Next easiest to calculate, we have $F_{AD} (= F_{DA})$ and $F_{AD} \perp F_{AB}$



- $\pm\rightarrow \Sigma F_X = 0$: $2 - 2 - F_{AC}\cos\theta = 0$

$\Rightarrow F_{AC} = 0$

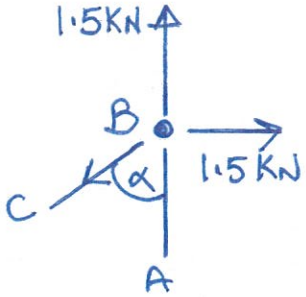
- $+\uparrow \Sigma F_Y = 0$: $F_{AC}\cos\alpha + F_{AB} = 0$

$\Rightarrow F_{AB} = 0$

Note: zero force members appear to be useless, however they are sometimes added to "stiffen" long beams and prevent buckling.

Joint B

Note: $F_{BA} = F_{AB} = 0$



- $+\uparrow \Sigma F_Y = 0$:

$1.5 - F_{BC}\cos\alpha = 0 \Rightarrow F_{BC} = {}^{+}2.5$KN (T)

Note: $\cos\alpha = 3/5$