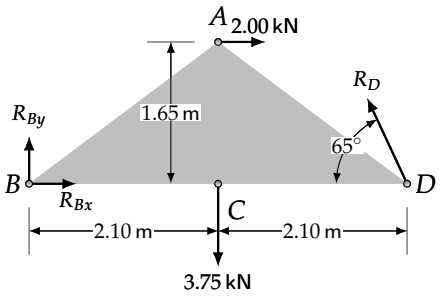
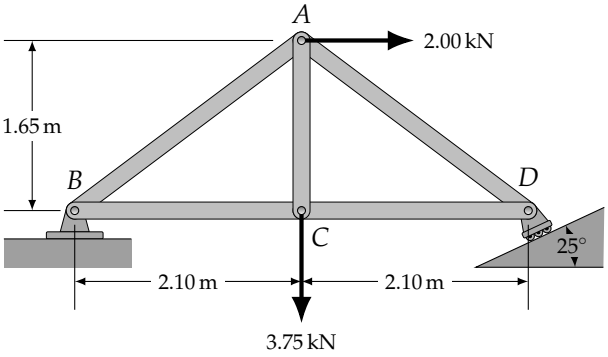
Engineering Statics - 07 Method of Joints - Instructor Copy

Example 1: Determine the force in each truss member.





Reactions

$$\Sigma M_B = R_D \sin 65^\circ \cdot 4.20\,\text{m} - 2.00\,\text{kN} \cdot 1.65\,\text{m} - 3.75\,\text{kN} \cdot 2.10\,\text{m} = 0$$

$$\Rightarrow R_D = \frac{2.00\,\text{kN} \cdot 1.65\,\text{m} + 3.75\,\text{kN} \cdot 2.10\,\text{m}}{\sin 65^\circ \cdot 4.20\,\text{m}} = 2.9358\,\text{kN}$$

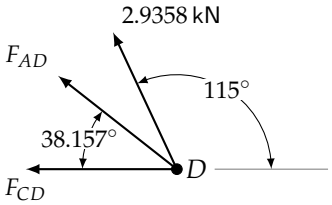
$$\Sigma F_x = R_{Bx} + 2.00\,\text{kN} - 2.9358\,\text{kN} \cdot \cos 65^\circ = 0$$

$$\Rightarrow R_{Bx} = -0.75928\,\text{kN}$$

$$\Sigma F_y = R_{By} - 3.75\,\text{kN} + 2.9358\,\text{kN} \cdot \sin 65^\circ = 0$$

$$\Rightarrow R_{By} = 1.0893\,\text{kN}$$

Joint D



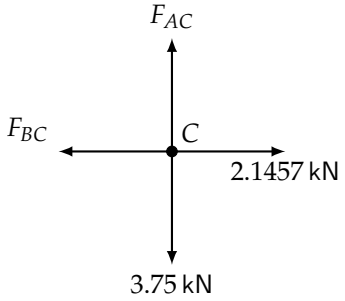
$$\Sigma F_y = 2.9358\,\text{kN} \cdot \cos 25^\circ + F_{AD} \sin 38.157^\circ = 0$$

$$\Rightarrow F_{AD} = -4.3067\,\text{kN}$$

$$\Sigma F_x = -F_{CD} - (-4.3067\,\text{kN}) \cdot \cos 38.157^\circ - 2.9358\,\text{kN} \cos 65^\circ = 0$$

$$\Rightarrow F_{CD} = 2.1457\,\text{kN}$$

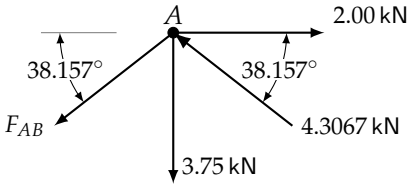
Joint C



$$F_{BC} = 2.1457\,\text{kN}$$

$$F_{AC} = 3.75\,\text{kN}$$

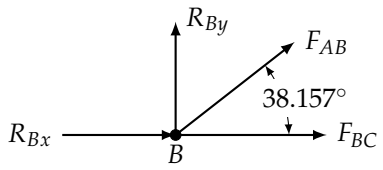
Joint A



$$\Sigma F_x = 2.00\,\text{kN} - 4.3067\,\text{kN} \cdot \cos 38.157^\circ - F_{AB} \cdot \cos 38.157^\circ = 0$$

$$\Rightarrow F_{AB} = \frac{2.00\,\text{kN} - 4.3067\,\text{kN} \cdot \cos 38.157^\circ}{\cos 38.157^\circ} = -1.7632\,\text{kN}$$

Check at B



$$\Sigma F_y = R_{By} + F_{AB} \cdot \sin 38.517^\circ$$

$$= 1.0893\,\text{kN} + (-1.7632\,\text{kN}) \cdot \sin 38.517^\circ$$

$$= -0.0087272\,\text{kN} \approx 0 \qquad \checkmark$$

$$\Sigma F_y = R_{Bx} + F_{AB} \cdot \cos 38.517^\circ + F_{BC}$$

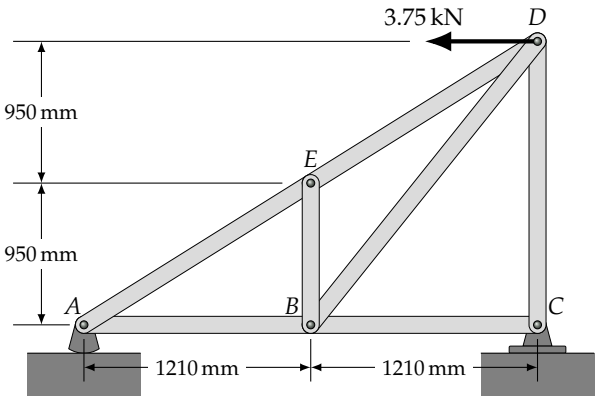
$$= (-0.75928\,\text{kN}) + (-1.7632\,\text{kN}) \cdot \cos 38.517^\circ + 2.1457\,\text{kN}$$

$$= -0.000020803\,\text{kN} \approx 0 \qquad \checkmark$$

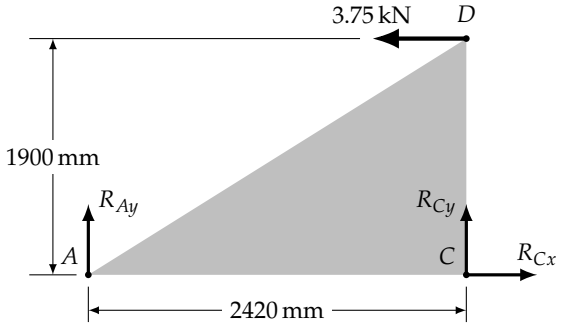
Answers

$AB = 1.76\,\text{kN}$	(Compression)
$BC = 2.15\,\text{kN}$	(Tension)
$CD = 2.15\,\text{kN}$	(Tension)
$AC = 3.75\,\text{kN}$	(Tension)
$AD = 4.13\,\text{kN}$	(Compression)

Example 1: Determine the force in each truss member.



FBD and external forces



$$\Sigma M_C = (3.75\,\text{kN})\cdot(1.900\,\text{m}) - R_{Ay}\cdot(2.420\,\text{m}) = 0$$
$$\Rightarrow R_{Ay} = 2.9442\,\text{kN}\cdot\text{m}$$

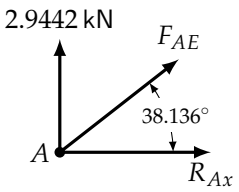
$$\Sigma F_x = R_{Cx} - 3.75\,\text{kN} = 0$$
$$\Rightarrow R_{Cx} = 3.75\,\text{kN}$$

$$\Sigma F_y = R_{Cy} + 2.9442\,\text{kN} = 0$$
$$\Rightarrow R_{Cy} = -2.9442\,\text{kN}$$

Note:

1. BE is a zero-force member
2. Since, BE is a zero force member, so is BD
3. Thus, $F_{AE} = F_{ED}$ and $F_{AB} = F_{BC}$

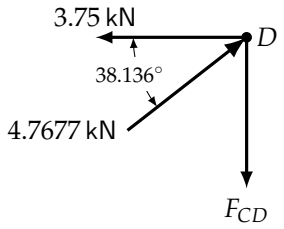
Joint A:



$$\Sigma F_y = F_{AE}\cdot\sin 38.136^\circ + 2.9442\,\text{kN} = 0$$
$$\Rightarrow F_{AE} = -4.7677\,\text{kN}$$

$$\Sigma F_x = (-4.7677\,\text{kN})\cdot\cos 38.136^\circ + R_{Ax} = 0$$
$$\Rightarrow F_{AB} = 3.7500\,\text{kN}$$

Joint D:



$$\Sigma F_y = (4.7677\,\text{kN})\cdot\sin 38.136^\circ - F_{CD} = 0$$
$$F_{CD} = 2.9442\,\text{kN}$$

Answers

$AB = 3.75\,\text{kN}$	(Tension)
$AE = 4.77\,\text{kN}$	(Compress)
$BC = 3.75\,\text{kN}$	(Tension)
$BD = 0$	
$BE = 0$	
$CD = 2.94\,\text{kN}$	(Tension)
$DE = 4.77\,\text{kN}$	(Compression)