Changing the axes at a joint in nodal analysis

The full key example for nodal analysis can be found here. This is additional to that document.

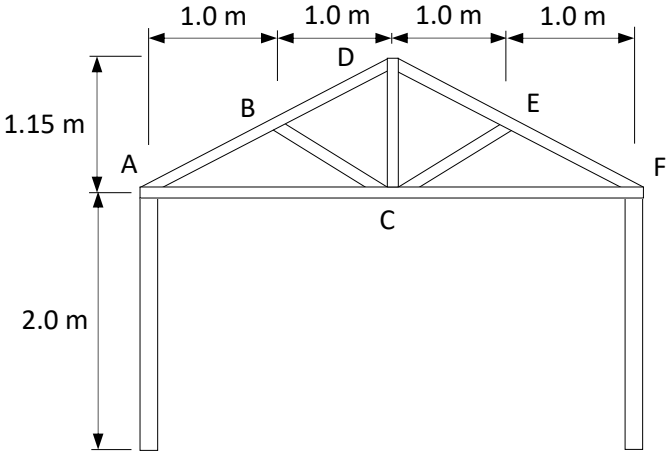

Figure 1 Roof truss
(ARBRE EVOLUTION,
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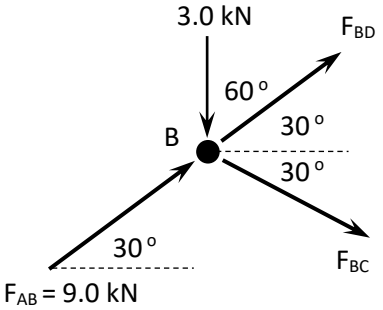
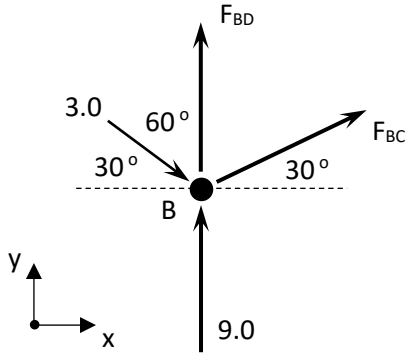
If there are two unknowns at a joint in nodal analysis, in order to avoid having to solve a set of simultaneous equations, one can use a different set of axes. This document explains how to do that.

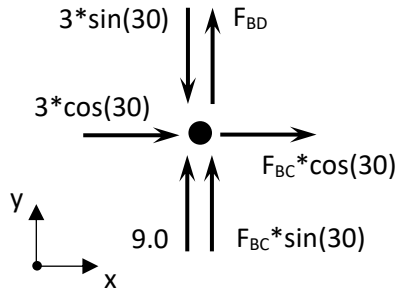
Analysing joint B



The force F_{AB} at joint B in this free body diagram was calculated as 9.0 kN compression. Resolving F_{BC} and F_{BD} into the horizontal and vertical directions would require having to solve a set of simultaneous equations.



This can be avoided by resolving the forces into a set of axes such that one of the unknown forces acts in the direction of either the x or y axes. For example, rotating the diagram by 60 ° anticlockwise as shown, results in an xy set of axes in which only one unknown force (F_{BC}) has a component in the new x direction.



The forces are resolved into their vertical and horizontal components in the rotated position. Now apply the principle of equilibrium.

Equilibrium in the x direction: $\Sigma Fx = 0$

$3*\cos(30) + F_{BC}*\cos(30) = 0$

$F_{BC} = - 3*\cos(30)/\cos(30)$

$F_{BC} = - 3$ kN (compression)

Equilibrium in the y direction: $\Sigma Fy = 0$

$F_{BD} + 9 + F_{BC}*\sin(30) – 3*\sin(30) = 0$

$F_{BD} = - 9 – (- 3)*\sin(30) + 3*\sin(30)$

$F_{BD} = - 6$ kN (compression)

Process

1. If there are two unknowns at a joint - Force A and Force B - and neither of them are parallel to either the x or y axes, make the direction of one of the unknown forces - say Force A - act along either the x or y axis of a new set of coordinates.
2. Resolve all forces into the new coordinate directions.
3. Solving the equation of equilibrium for force at right angles to the line of Force A will give the value of Force B. The value of Force A is then found from the equation of equilibrium in its own direction.

Metadata

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