Basic knowledge

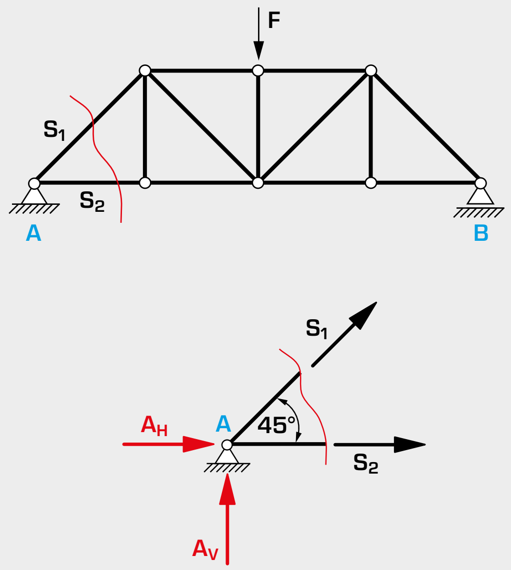
Method of sections for plane trusses

Plane trusses are structures that only comprise straight bars. The bars are connected to nodes. To determine the support reactions and the forces and moments that are transferred to the nodes, we first make idealising assumptions:

1. The bars are connected to each other at the nodes, centrally and flexibly.
2. The external forces only act on the nodes.

These requirements for an ideal truss ensure that all bars are only subjected to tension or pressure. The support forces and bar forces are calculated using various methods of sections.

Method of joints

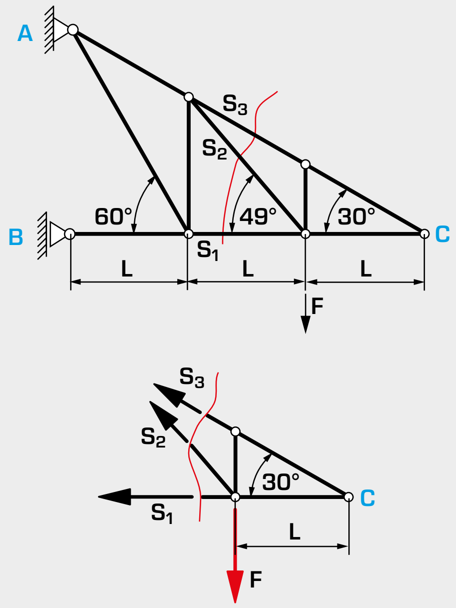


S bar forces, A+B support forces, F forces, index V vertical forces, index H horizontal forces

Using the method of joints, all nodes are isolated in succession. The equilibrium conditions are established at each node. Applying the method of joints requires that no more than two unknown forces are acting on the node. The advantage of this method is that no bar force is overlooked in complex trusses.

Equilibrium condition	$\sum F_V = 0 = A_V + S_1 \sin 45°$ $\sum F_H = 0 = S_2 + S_1 \cos 45° + A_H$

Ritter's method of sections

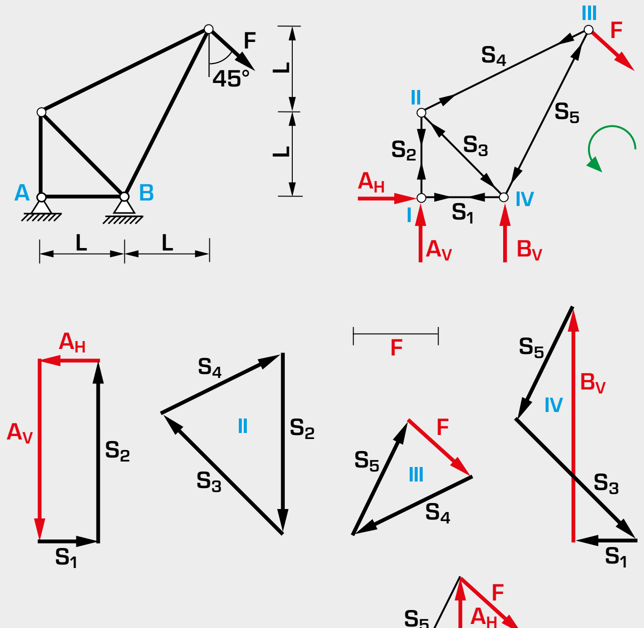


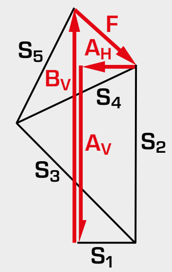
S bar forces, A+B support forces, C nodes, F force, L bar length, S_2 wanted bar force

Ritter's method of sections is used when only single bar forces need to be determined in a truss. Applying Ritter's method of sections requires that the supporting and external forces are known. The section runs through three bars, of which two bars are connected in a node. In the case of the equilibrium of moments, it makes sense to choose the intersection of the two bar forces as the reference point. Consequently, only one unknown bar force remains in the equation. The advantage of this method is that it is possible to calculate individual bar forces without having to consider every node.

Equilibrium condition	$\sum F_V = 0 = -F + S_2 \sin 49° + S_3 \sin 45°$ $\sum F_H = 0 = -S_3 \cos 30° - S_1 - S_2 \cos 49°$ $\sum M_C = F \cdot L - S_2 \cdot \sin 49° \cdot L = 0$

Cremona diagram (forces diagram)





S_1 - S_5 bar forces,
A+B support forces,
I - IV nodes, F force,
index V vertical forces,
index H horizontal forces,
L length,
green: circumferential direction

The Cremona diagram is a **graphical method** for determining bar forces in a truss. Applying the Cremona diagram requires that the support forces and the external forces are known or that they have been determined beforehand using the method of joints. Then a force diagram is systematically plotted for each node with a known force and two unknown forces. The direction of force is plotted in the entire force diagram of the truss. The unknown bar forces can be derived from the triangle of forces. The advantage of this method is that no bar force is overlooked in complex trusses and all force directions are correctly plotted.