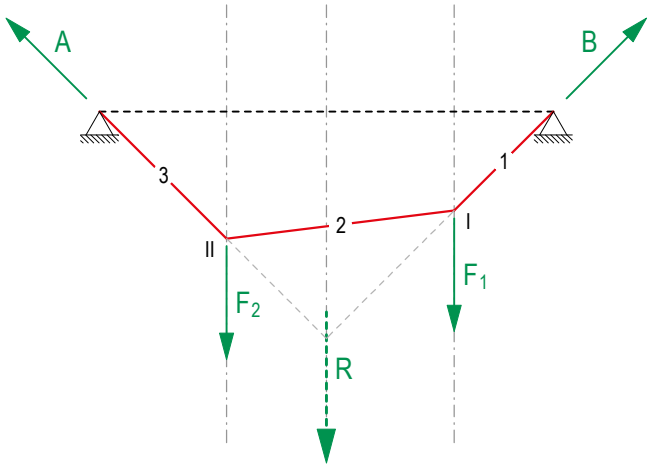
F1

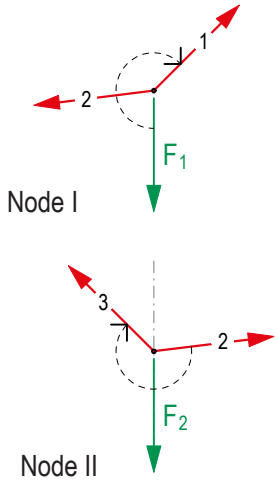
Structural Design I

Form Diagram - Force Diagram - Free Body Diagram

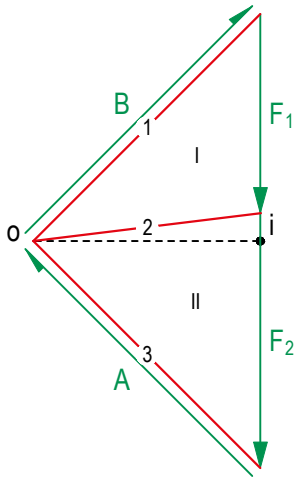
In graphic statics, forces of a structure are shown as vectors, and therefore two plans (form and force diagram) are being used. The form diagram shows the geometry of the structure to scale with all bearing elements and the location of the loads. The force diagram shows the external and internal forces to scale. Every line in force diagram corresponds to the parallel line in form diagram. The free body diagrams are sketches not to scale and show information about single nodes.



Form Diagram - scale 1:200



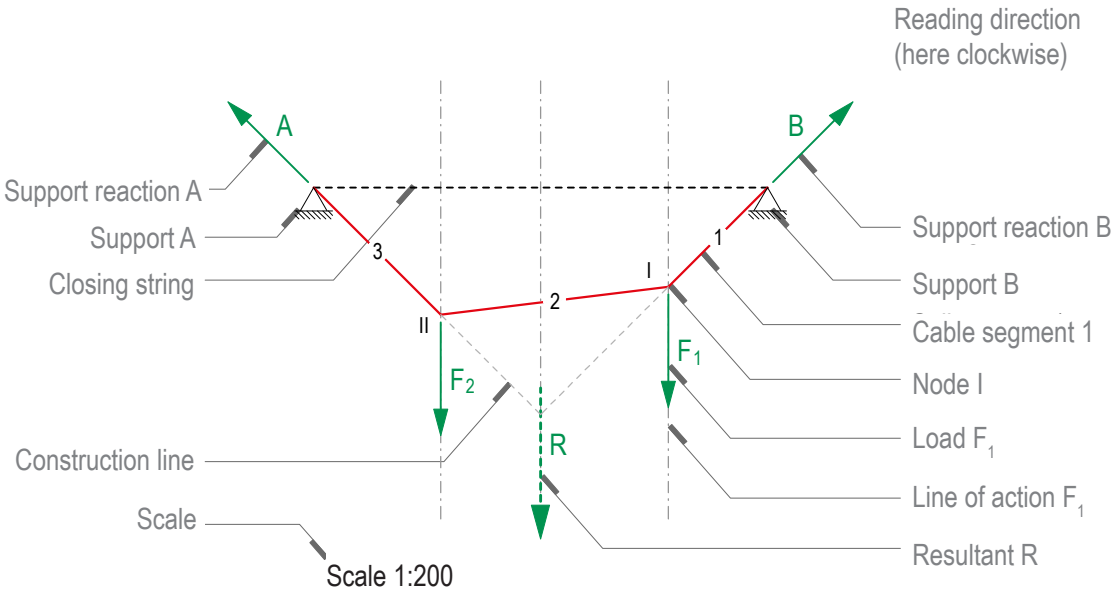
Free Body Diagram - no scale



Force Diagram - scale 1cm≙50kN

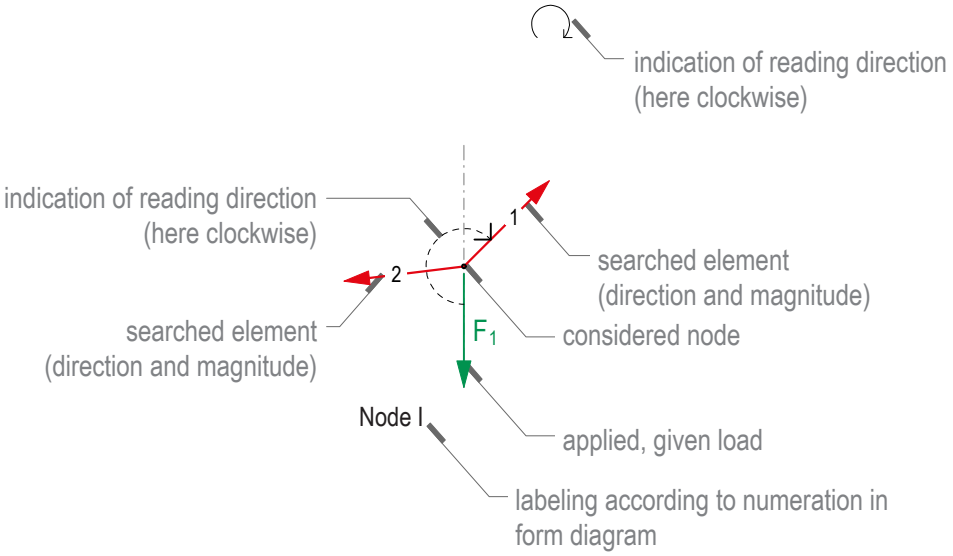
Form Diagram

The form diagram shows the geometry of the structure with all bearing elements and the location of loads. Loads (F_1 and F_2) and support reactions (A and B) are so called “external forces”and are shown with their direction (as an arrowhead). They are drawn in green colour. Forces within the structural elements (cable elements 1-3) are called „internal forces“ and have no distinct direction. Depending on the kind of load they are shown in red colour for tension or blue for compression. The form diagram has to be drawn to scale, e.g. 1:200 means that 1cm in plan equals 200cm in reality.



Free Body Diagram

The free body diagram (FDB) and the indicated reading direction declare the order of the elements that are to be drawn in the force diagram. The FDB is a sketch and thereby it is not to scale. It shows all forces and elements applied on the respective node and differentiates between given and searched elements. By transferring the direction of a force from force diagram to FDB, one can indicate tension (direction away from the node, usually colored red) and compression (direction towards the node, usually colored blue) elements.



Force Diagram

The force diagram is constructed by parallel moving the elements from the form diagram. The chosen reading direction and the respective free body diagram indicate the drawing order of the elements. Once the force diagram is drawn to scale, the magnitude of the forces can be measured, e.g. 1cm = 50kN means that 1cm in the force diagram equals a force of 50kN.

Global and Local Equilibrium

The load line is a force polygon of all external forces (action and reaction forces). The total system is in equilibrium (global equilibrium), if the polygon is closed. One separate node (free body diagram) is in equilibrium state if all forces, that affect this node, form a closed polygon in force diagram. The forces polygon is defined as a model for local equilibrium of the internal forces.