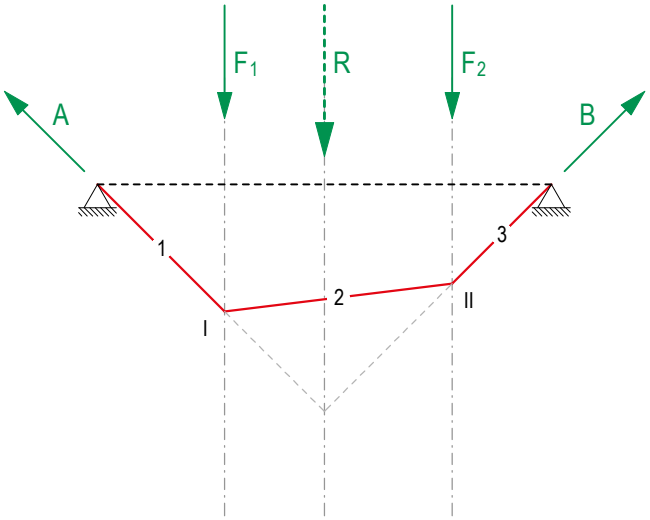
2.1

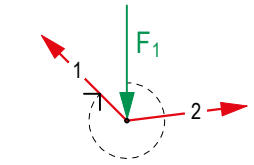
Compendium Structural Design I & II

Form Diagram – Subsystem – Force Diagram

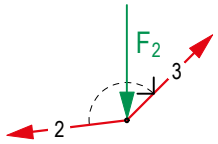
In graphic statics, the forces of a structure are displayed as vectors in two diagrams, the form diagram and the force diagram. The form diagram shows the geometry of the structure with all bearing elements and the position of the loads. The forces at and in the supporting elements are shown in the force diagram. Each line in the form diagram corresponds to a parallel line in the force diagram. The subsystems serve as sketches and show information regarding the individual nodes.



Form Diagram 1:100

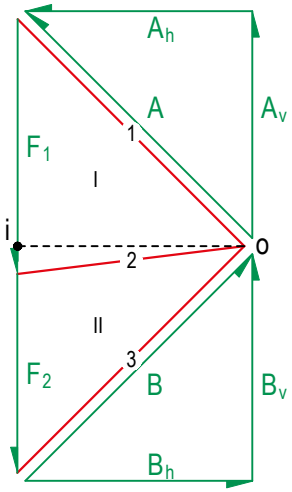


Node I



Node II

Subsystem (without scale)



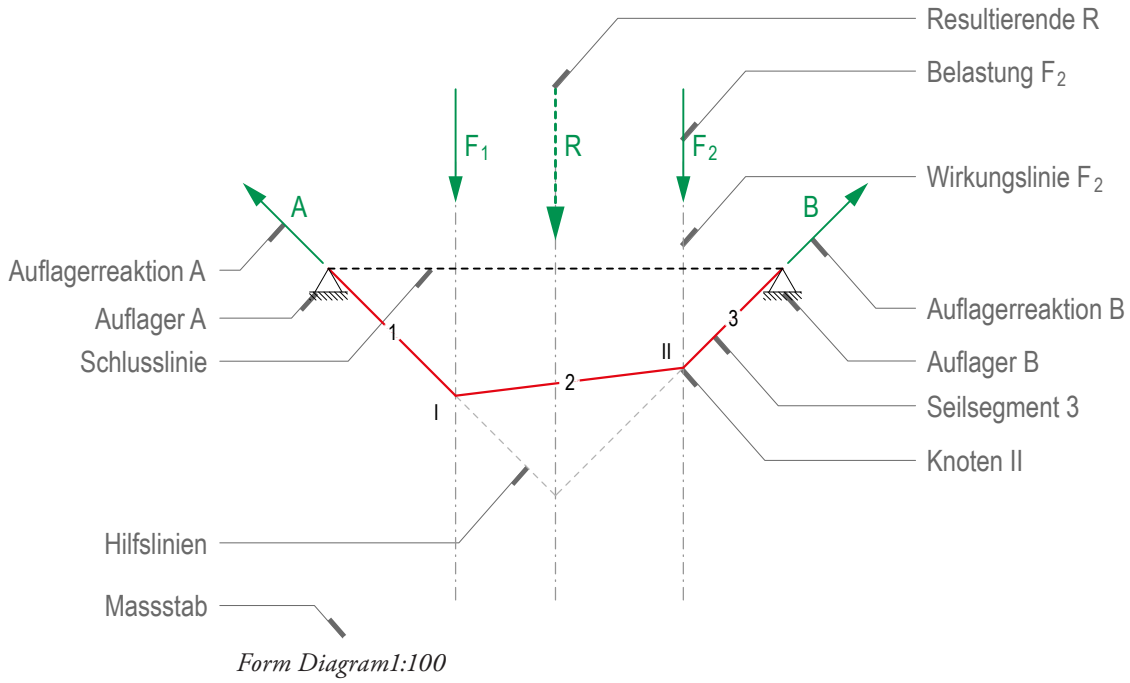
Force Diagram 1cm ≙ 10kN

2.1

Form Diagram – Subsystem – Force Diagram

Form diagram

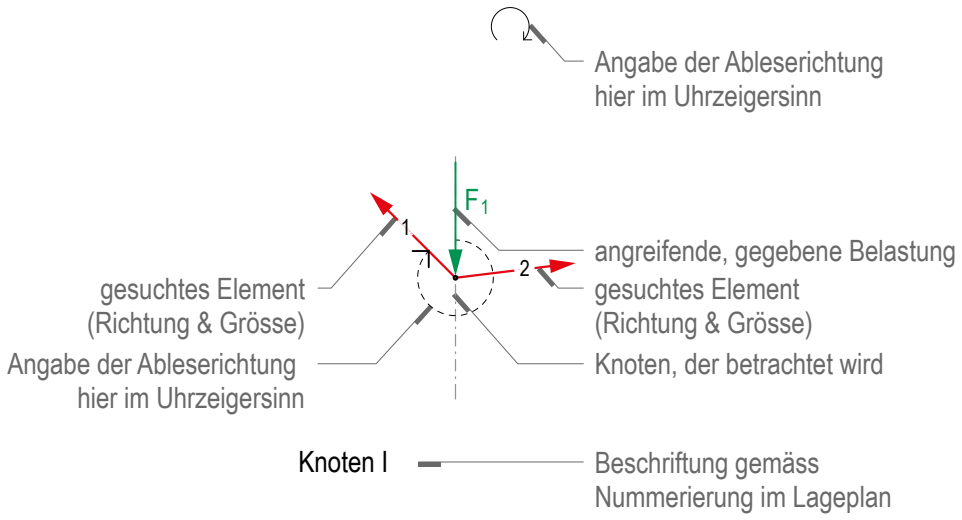
The form diagram shows the geometry of the structure with all bearing elements and the position of the loads. Loads (F_1, F_2) and reaction forces (A, B) are called „external forces“ and are drawn with their direction (as an arrow). They are drawn in the colour green. Forces in the structural elements (segments 1-3) are called internal forces and do not have a clear direction. They are coloured red for tension and blue for compression depending on the type of stress. The form diagram is drawn in a certain scale. Example: 1:100 means that 1 cm in the plan corresponds to 100 cm in reality.



Form Diagram1:100

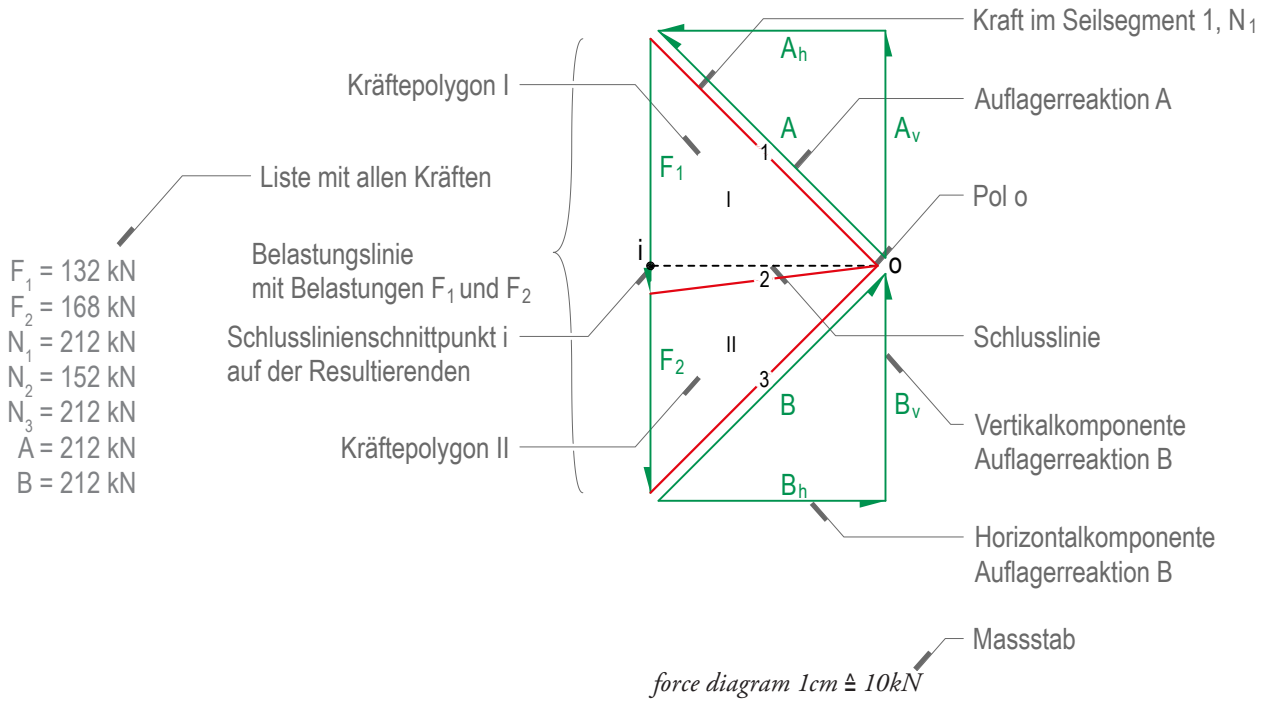
Subsystem

The subsystem (also free body diagram – FBD) and the reading direction declare the order of the elements that are to be drawn when constructing the force diagram. The subsystem is displayed without scale, usually as a sketch. In the subsystem the forces / elements acting on the nodes are drawn and a distinction is made between given and searched elements. With the subsystem and the force directions it contains, it can be determined whether the structural element is loaded in tension or compression. If the force points towards the node, it is a compression force (blue). If it points away from the node, it is a tensile force (red).



Force diagram

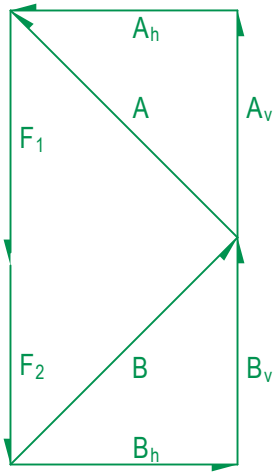
The force diagram is constructed by parallel shifting of the structural elements from the form diagram. The chosen reading direction and the corresponding subsystem indicate the drawing order of the elements. The magnitudes of the forces can then be measured directly from the complete force diagram using the given scale. 1cm ≙ 50kN means that 1cm in the plan corresponds to a force of 50 kN.



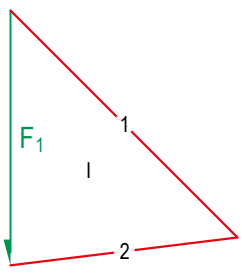
force diagram 1cm ≙ 10kN

Global and local equilibrium

The load line is the force polygon of all external forces (actions and reaction forces). If the polygon is closed, the entire system is in equilibrium (global equilibrium). A single node (subsystem) is in equilibrium if all forces acting on the node form a closed polygon in the force diagram. The force polygon is the model of the local equilibrium of the internal forces.



global equilibrium



local equilibrium node I