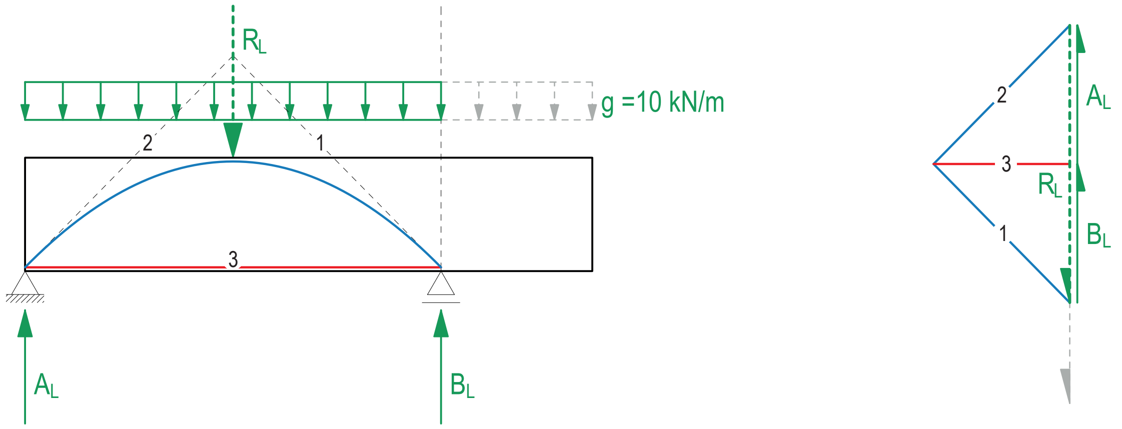
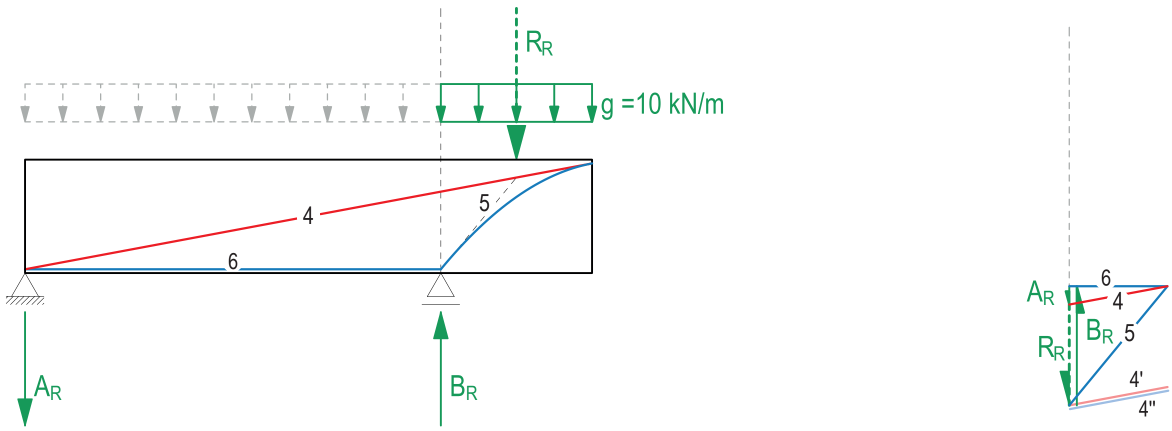
7.3 Force Flow in a Beam: Superposition

We are looking for a possible force flow in the beam that distributes the applied line load into the two supports. To solve such a combined system that both spans and cantilevers, the line load is divided into two subsystems. Both subsystems are subsequently considered separately and superimposed at the end.

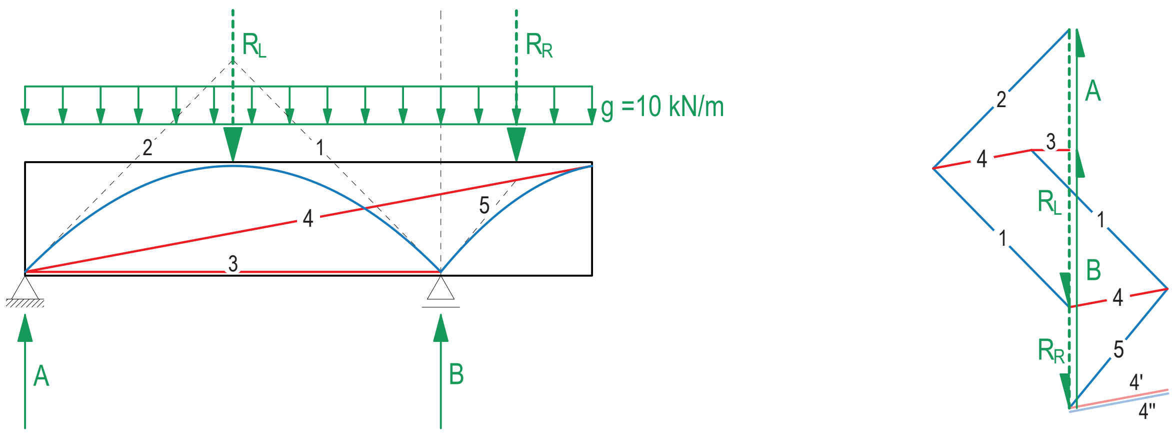
First, the global equilibrium in the left subsystem is determined. Under the given load, a parabola results between the supports, whose horizontal thrust must be absorbed by means of a tension element.



Then the global equilibrium of the subsystem on the right is determined. The parabola that occurs under this load does not run into a support on the far right side of the beam. This compression force must therefore be pulled back by a tension element. It is important that the direction of the right tangent of the arch corresponds to that of the tension element and that the two elements thus cancel each other out. To compensate for the horizontal component of the arch in support B, an additional compression element is needed between the supports.



Finally, the two subsystems are graphically superimposed. In the force diagram, the global equilibrium of the two subsystems can first be added and then the internal forces can be combined node by node. From the two force diagrams above, it can be seen that the element between the supports absorbs a larger tension force, which is why the superposition must also be a tension element (3).



form diagrams 1:100

force diagrams 1cm ≙ 15kN