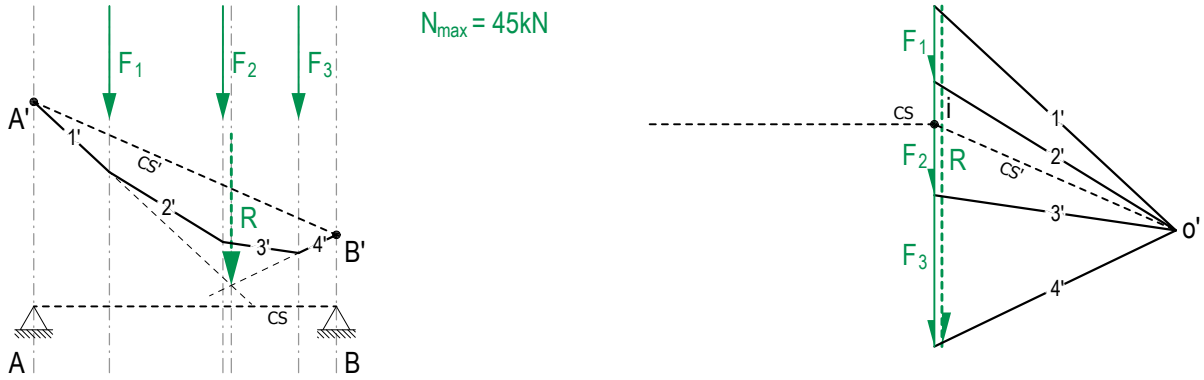
4.2

Compendium Structural Design I&II

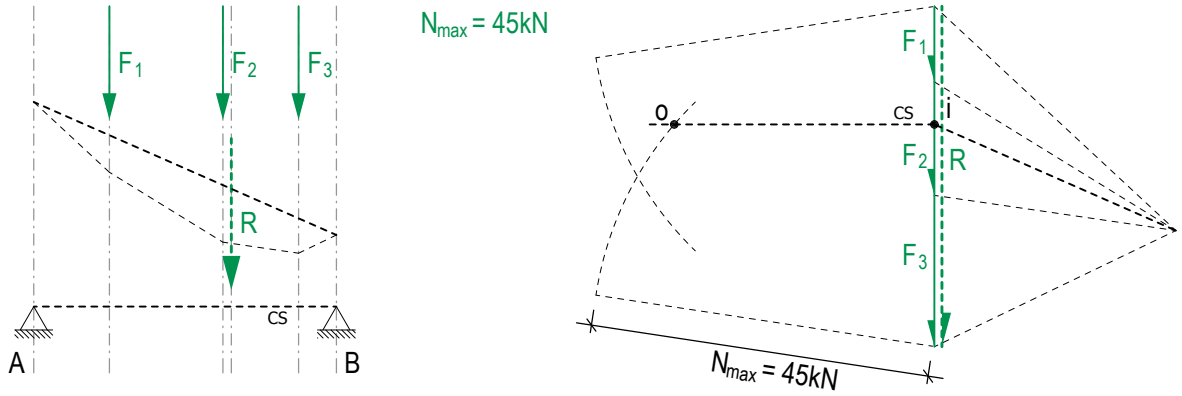
Form-finding under specific constraints

Three acting forces are given. The form of an arch in which the maximum force does not exceed 45kN is sought.

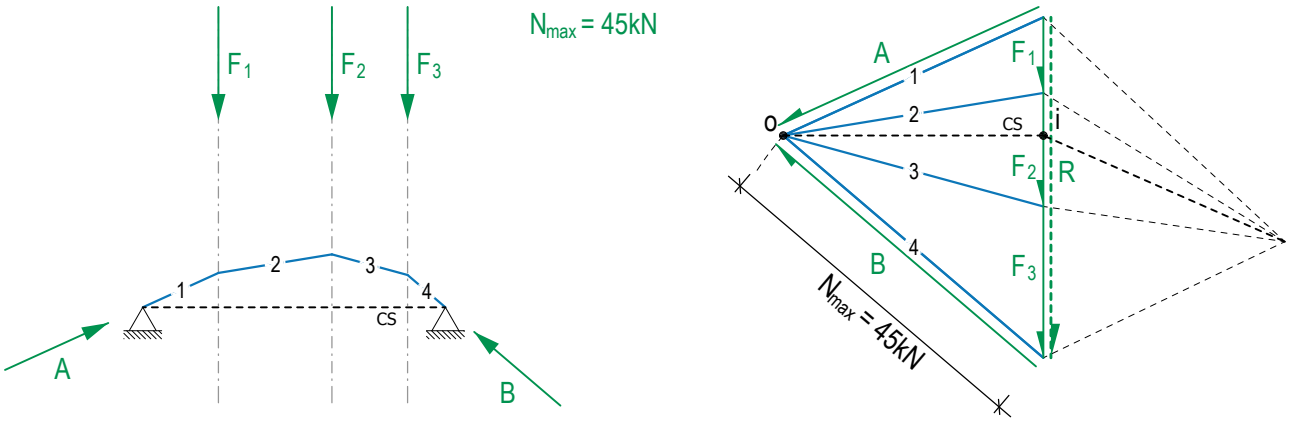
The position of the resultant and the auxiliary supports A‘ and B‘ are localized by means of a trial funicular construction. The closing string of the trial funicular CS‘ is shifted through the pole o‘ and intersects with the resultant at point i. The closing string CS also runs through i.



Since the forces are largest at the supports, the global equilibrium is now to be determined. The magnitude of the force is given, but not its direction. Therefore, the given 45kN are measured off with a compass from the beginning and the end of the resultant. Of the two resulting points of intersection with the closing string, the one closer to i is relevant - this is the pole o.



Finally, the rays can be transferred one after the other to the form diagram. The drawn arch has the minimum structural depth, which fulfils the requirement $N_{dmax} \leq 45kN$. With the specification of a maximum internal force, steeper arches are also possible, since the internal forces decrease with increasing structural depth. For other possible solutions, the pole o is therefore closer to i.



form diagrams 1:100

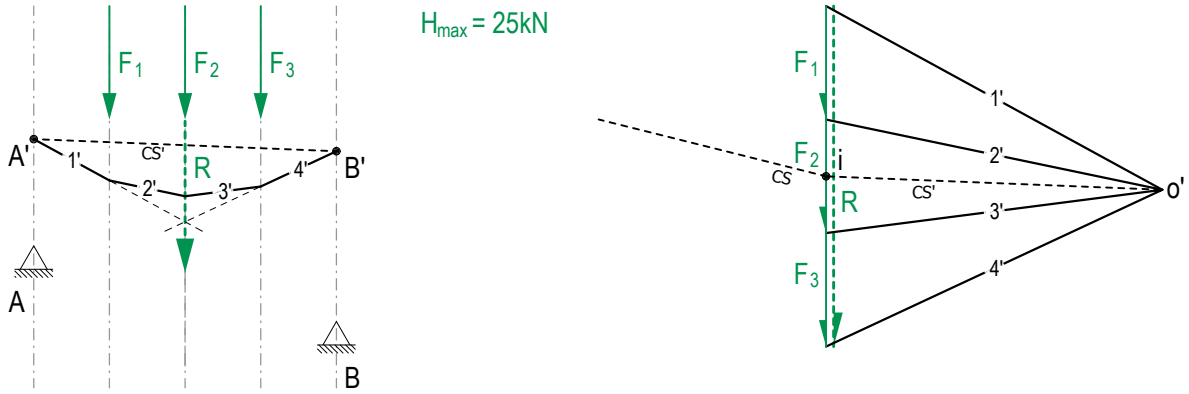
force diagrams 1cm ≙ 10kN

4.2

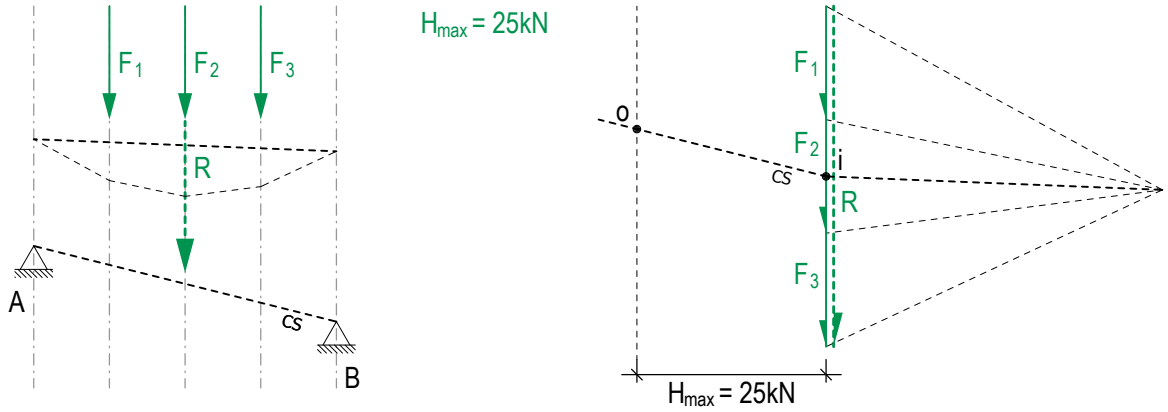
Form-finding under specific constraints

Three acting forces and asymmetrically positioned supports is given. The form of an arch in which the horizontal thrust in the supports does not exceed 25kN is sought.

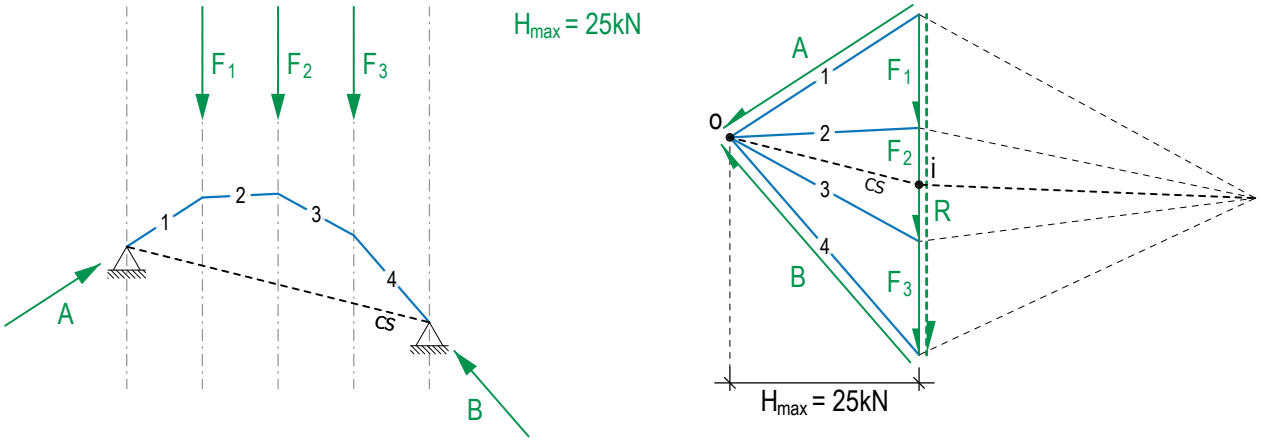
The position of the resultant and the auxiliary supports A‘ and B‘ are localized by means of a trial funicular construction. The closing string of the trial funicular CS‘ is shifted through the pole o‘ and intersects with the resultant at point i. The closing string CS also runs through i.



Now the maximum thrust H_{max} is transferred into the force diagram. For this purpose, a line is drawn parallel to the resultant, marking the maximum thrust in the supports. The pole is located at the intersection of this line with the closing string CS.



Finally, the rays can be transferred one after the other to the form diagram. The drawn arch has the minimum structural depth, which meets the requirement $H_{max} \leq 25kN$. With the specification of a maximum horizontal component, steeper arches are also possible, since the thrust decreases with increasing structural depth. For further possible solutions the pole o is therefore closer to i.



form diagrams 1:100

force diagrams 1cm ≙ 10kN