

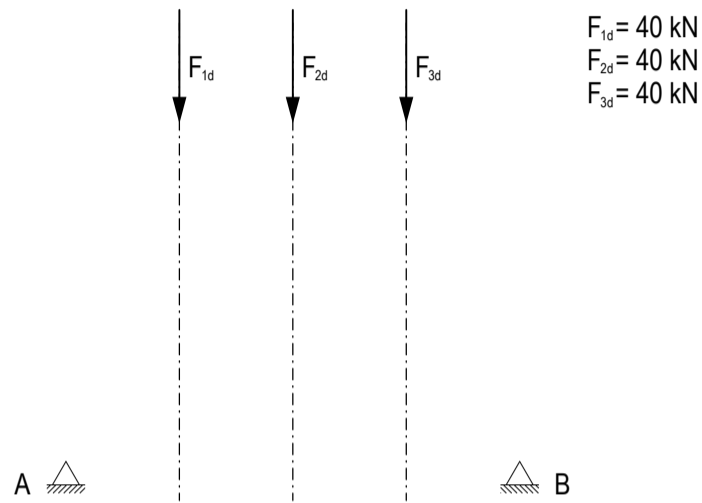
Task 1 Arches under specific constraints

Find a possible form for an arch for the loading cases in situations a) and b). Consider the conditions below. Draw tension forces in red, compression forces in blue and reaction forces in green. §

In a) the relevant force should be 100 kN.

In b) the thrust (horizontal component of the reaction forces) equals 120 kN.

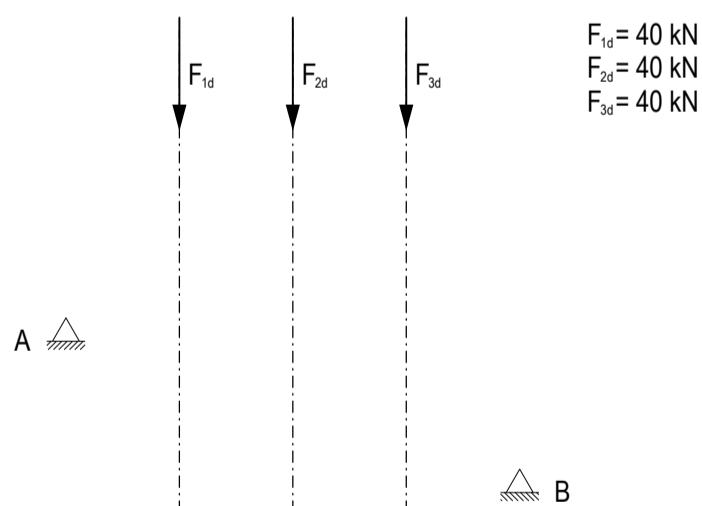
a)



form diagram 1:100

force diagram 1cm ≙ 20kN

b)



form diagram 1:100

force diagram 1cm ≙ 20kN

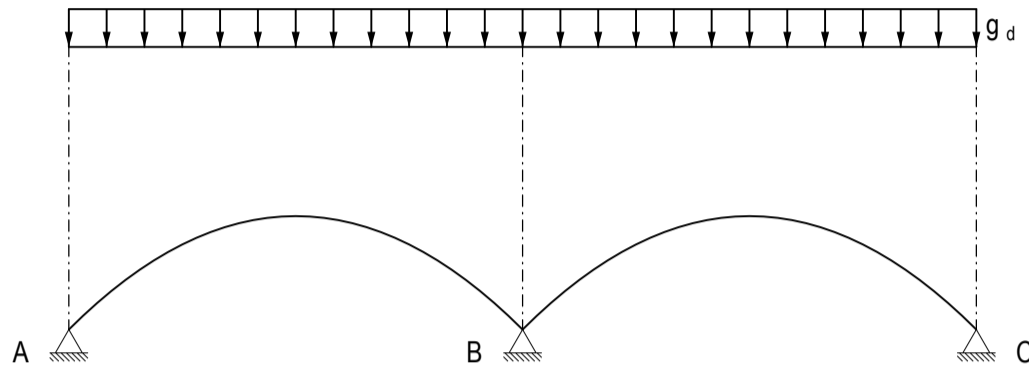
c) Are there other possible solutions for the cases above? If yes, draw an additional possible solutions qualitatively (only in the form diagram, without drawing the force diagram).

Task 2 Support Reactions in Arch Structures

There are three situations below. Consider in each case the designed line load of $g_d = 4 \text{ kN/m}$.

- Two arches are placed next to each other. Use graphic statics to find all the reaction forces (A-C) and draw the force diagram.
- Find again the force diagram.
- How does the reaction force B change from case a) to b)?
- The support B only allows a vertical reaction force. Find the form of the missing arch with help of the force diagram so that the thrust of both arches are cancelling each other out in support B.

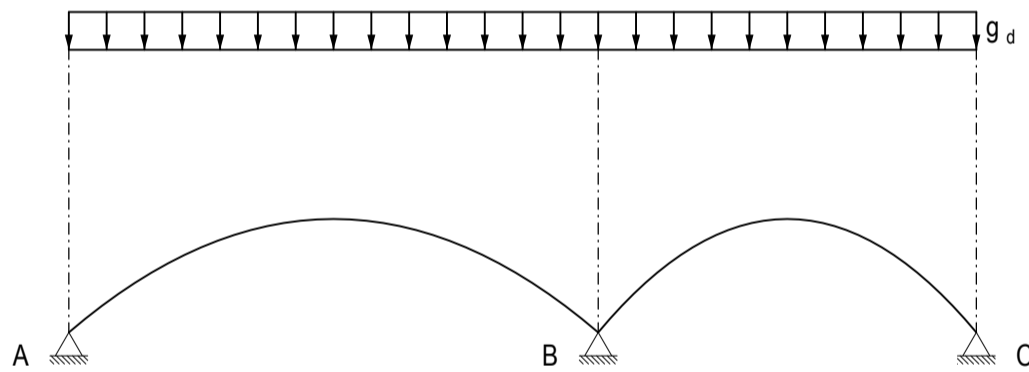
a)



form diagram 1:200

force diagram 1cm $\hat{=}$ 10kN

b)



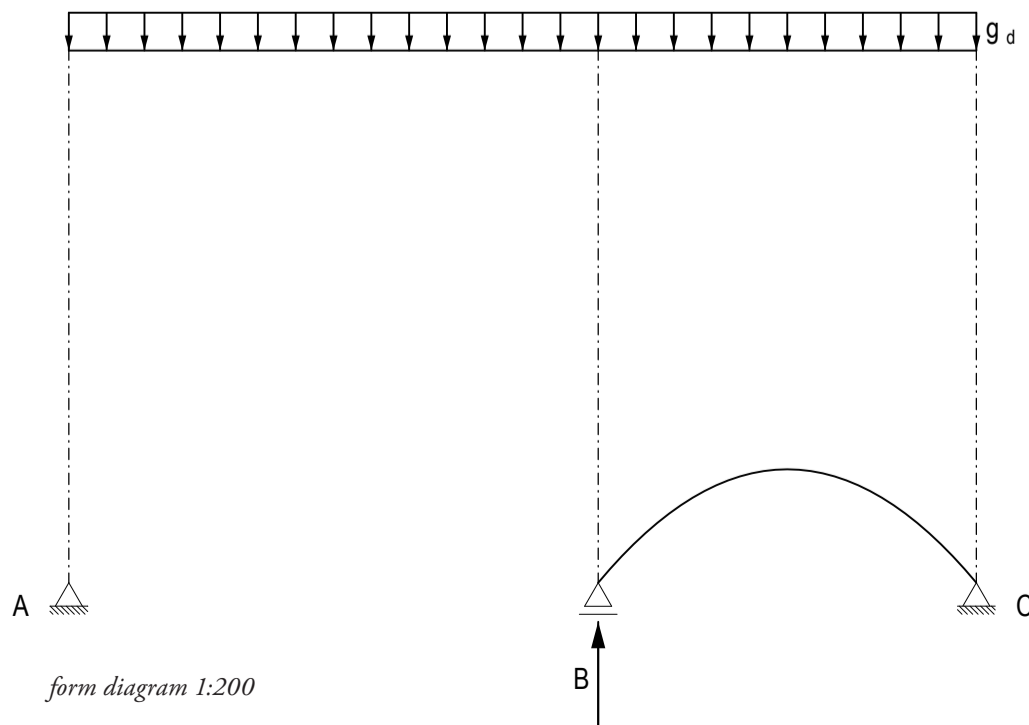
form diagram 1:200

force diagram 1cm $\hat{=}$ 10kN

c)



d)



form diagram 1:200

force diagram 1cm $\hat{=}$ 10kN

Creative Cathedral

Task

Complete the given cross section of the vault of the main nave of a cathedral with your own design of side naves and supporting walls. Draw the inner force flow in the construction with help of the force diagram and adjust your design if necessary. The forces have to be led into the ground through the structure. Keep in mind that a stone construction works in compression only.

- The inner force flow in the vault of the main nave is already given. First, find the geometry of the vault of the left side nave. Take into account the vertical walls inbetween the main and the side nave which define that the inner force has to be transferred vertically to the supports.
- Then coordinate the geometry of the left supporting wall with the external force F_{1d} , which you can freely choose.
- Apply the same procedure to design the structure of the right side nave.

