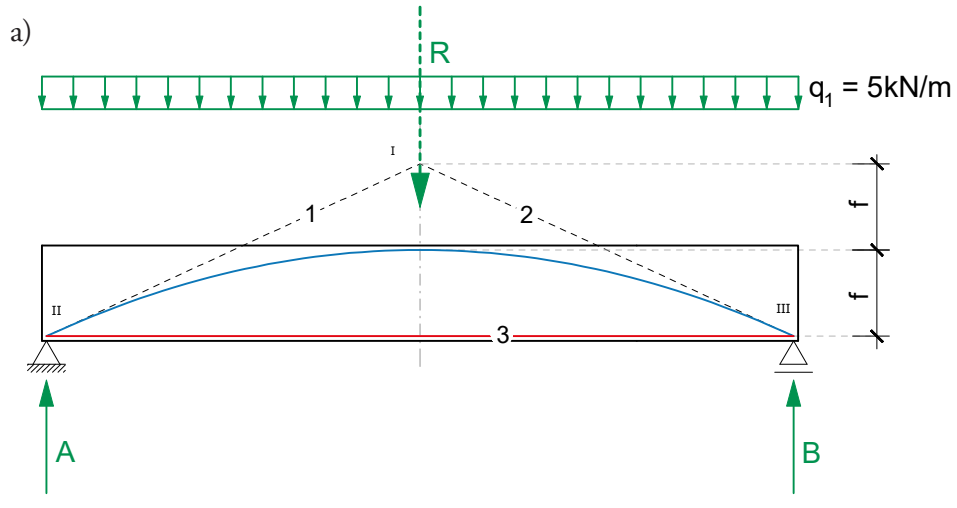
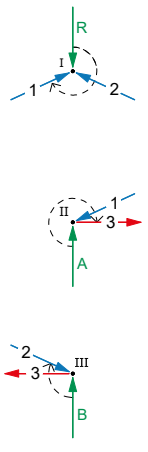
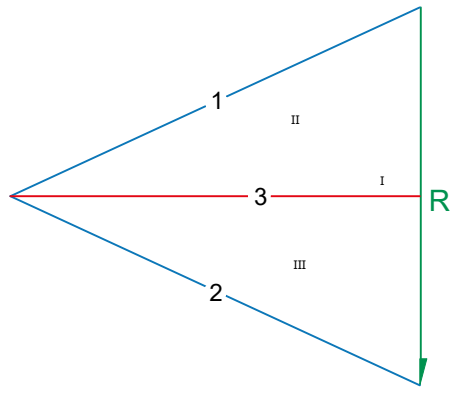
Task 1 Internal Force Distribution in a Cantilevered Beam

For cases a) and d) draw a possible solution for the distribution of the internal forces by means of an arch-cable structure. For b) and c) the internal forces are given. Draw the force diagrams for all cases and use red for tension forces and blue for compression.

a)



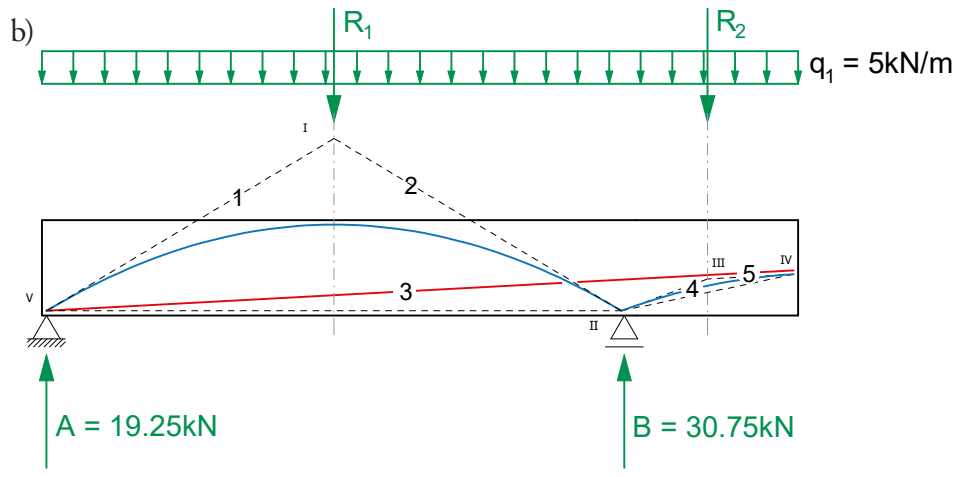


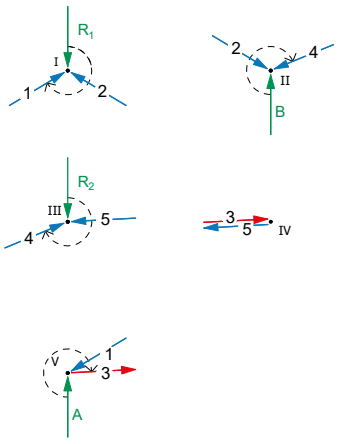


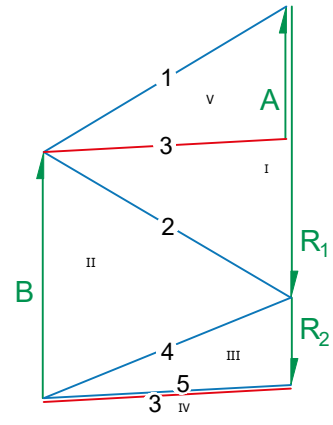
form diagram 1:100

force diagram 1cm ≙ 10kN

b)



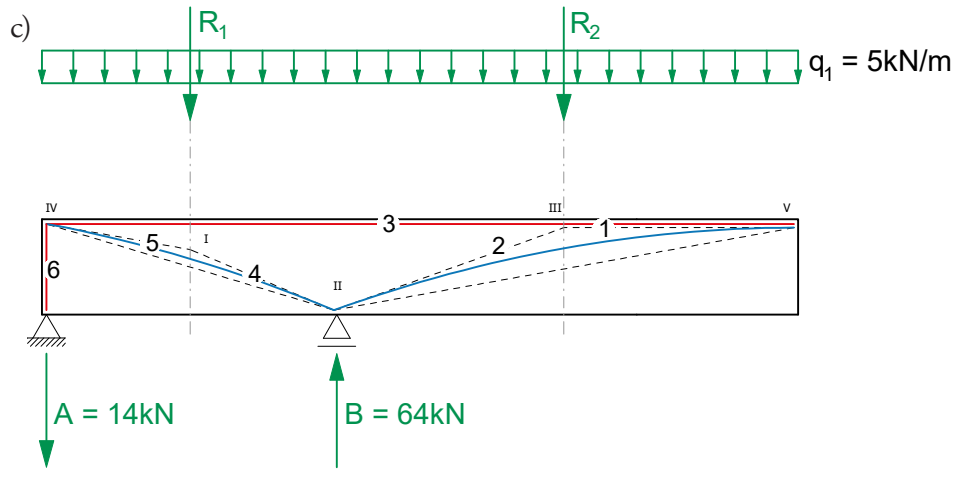


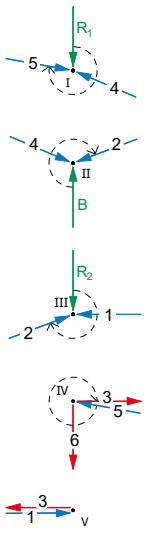


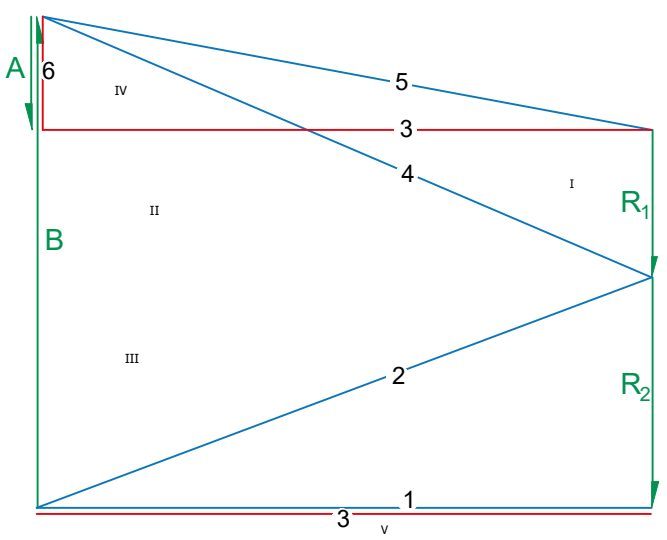
form diagram 1:100

force diagram 1cm ≙ 10kN

c)



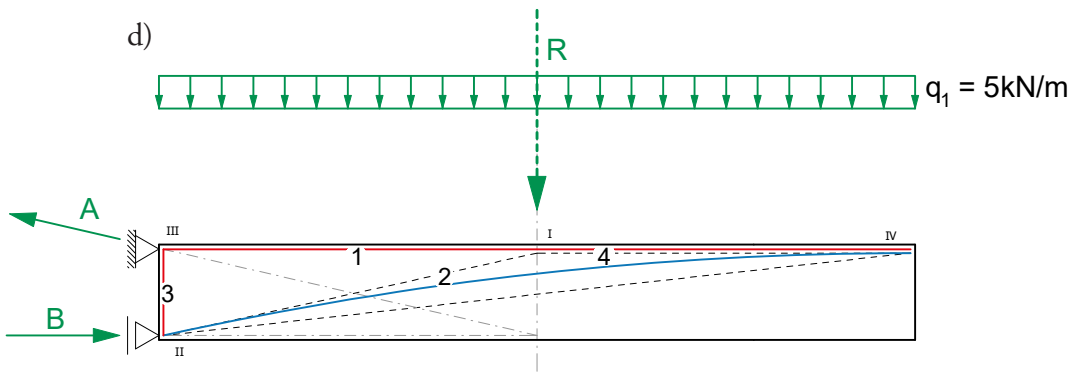


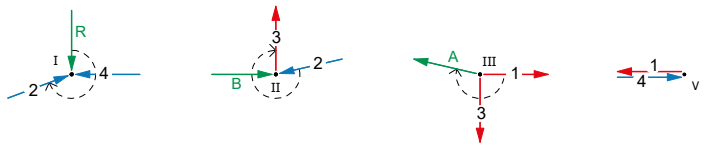


form diagram 1:100

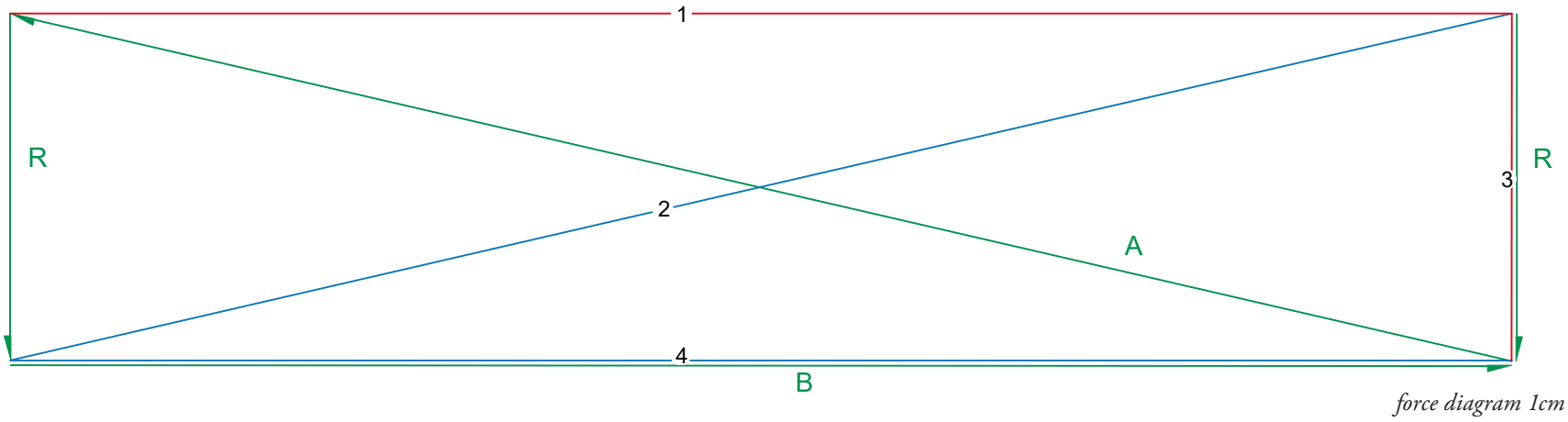
force diagram 1cm ≙ 10kN

d)





form diagram 1:100



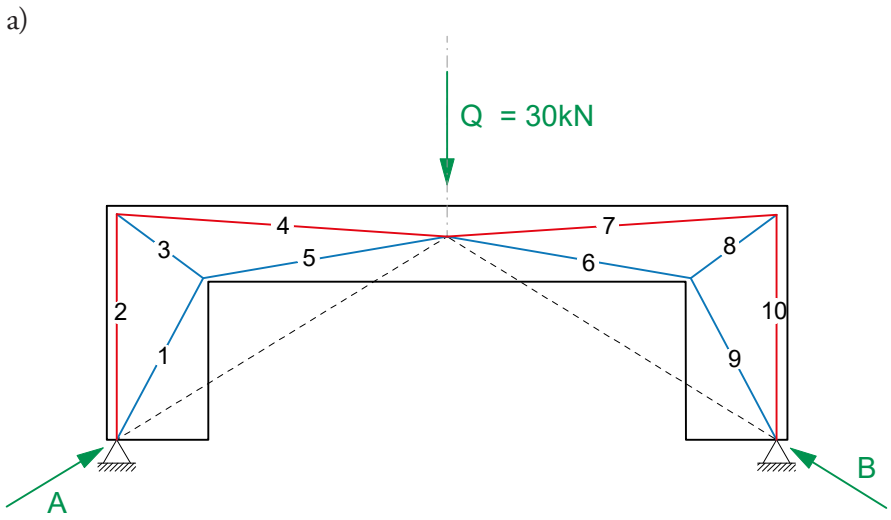
force diagram 1cm ≙ 10kN

Task 2 Statically indetermined supported frame

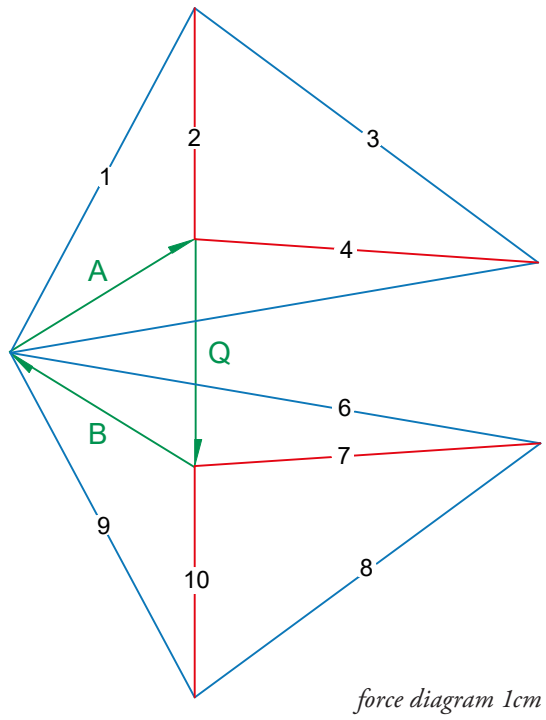
Two equal frames in reinforced concrete with different supports are given. In situation a) draw a possible internal force distribution as an arch-cable-construction with the aid of the force diagram.

Draw the corresponding force diagram to the given force distribution in b). Indicate in both a) and b) tension forces with red and compression forces with blue.

a)

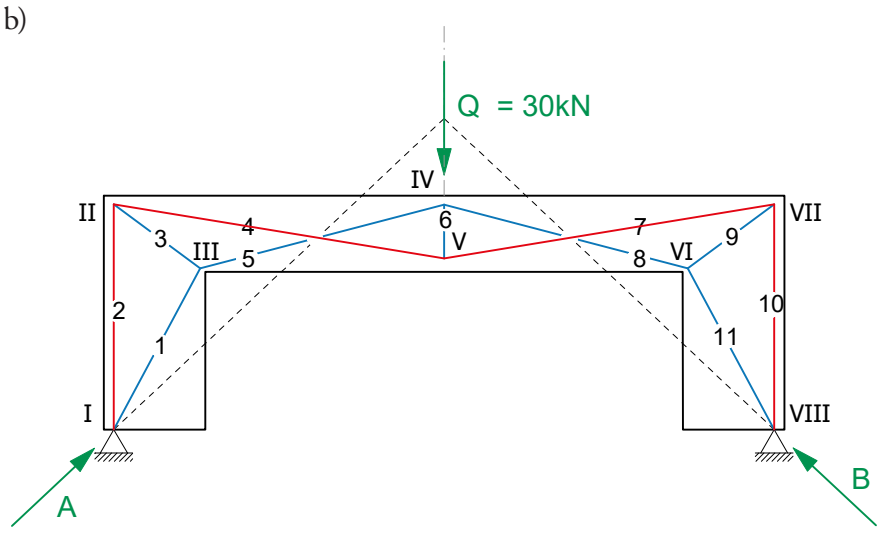


form diagram 1:100

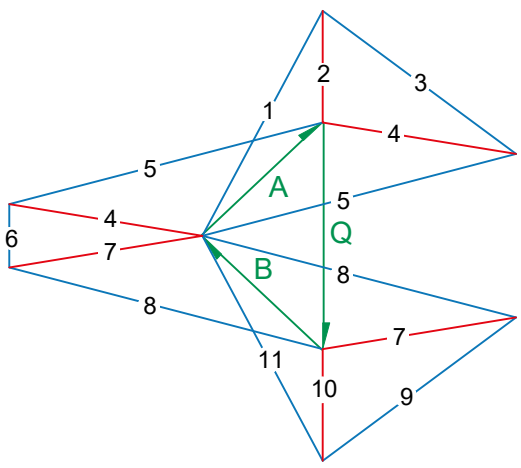


force diagram 1cm ≙ 10kN

b)



form diagram 1:100



force diagram 1cm ≙ 10kN

Dimensionierung

a) Dimension the reinforcement within the steel concrete for the relevant tension force of task 2 a). Use steel S235 to calculate the diameter and round the result off to mm. (Round up!)

b) Verify whether the frame in task 2 b) can keep up with the relevant compression force. The slab is 8 cm thick and is constructed in concrete C12/15. Presume the force would affect the frame over the width of 10 cm.

N_d = 46 kN

$f_{td} = f_{tk} / \gamma_M = 235 N/mm^2 / 1.05 = 223.8 N/mm^2$

$A = N_d / f_{td} = 46'000 N / 223.8 N/mm^2 = 205.54 mm^2$

$D = \sqrt{4 \cdot A / \pi} = \sqrt{4 \cdot 205.54 mm^2 / \pi} = 16.18 mm \approx 17 mm$

N_d = 43 kN

$f_{cd} = f_{ck} / \gamma_M = 12 N/mm^2 / 1.5 = 8 N/mm^2$

$A_{eff} = d \cdot b = 80mm \cdot 100mm = 8'000 mm^2$

$N_{allow} = f_{cd} \cdot A_{eff} = 8 N/mm^2 \cdot 8'000 mm^2 = 64'000 N$

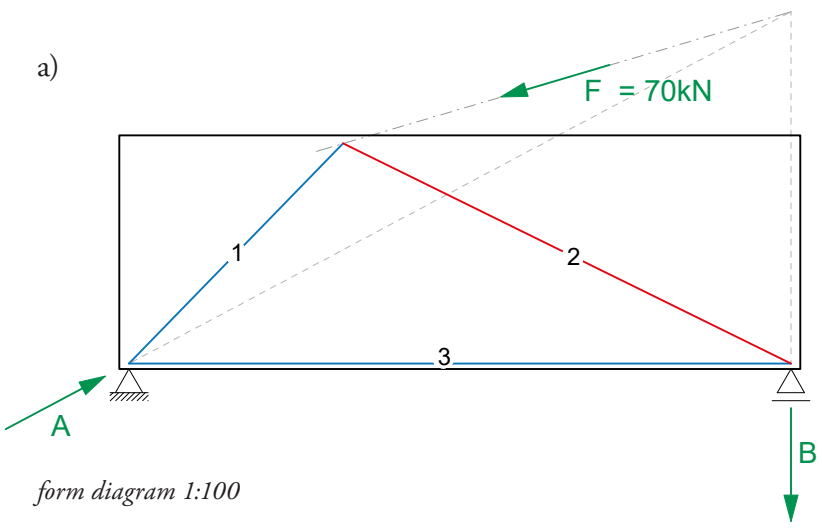
$N_d = 43'000 N \leq 64'000 N = N_{allow}$

Additional Task 1 — Statically determined supported wall slab

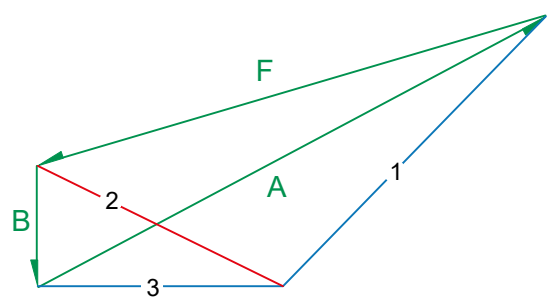
Four equal wall slabs in reinforced concrete but with different supports or loads are given. In situations a) to c) draw a possible internal force distribution as an arch-cable-structure with the aid of the force diagram.

Draw the coresponding force diagram to the given force distribution in d). Indicate tension forces with red and compression forces with blue.

a)

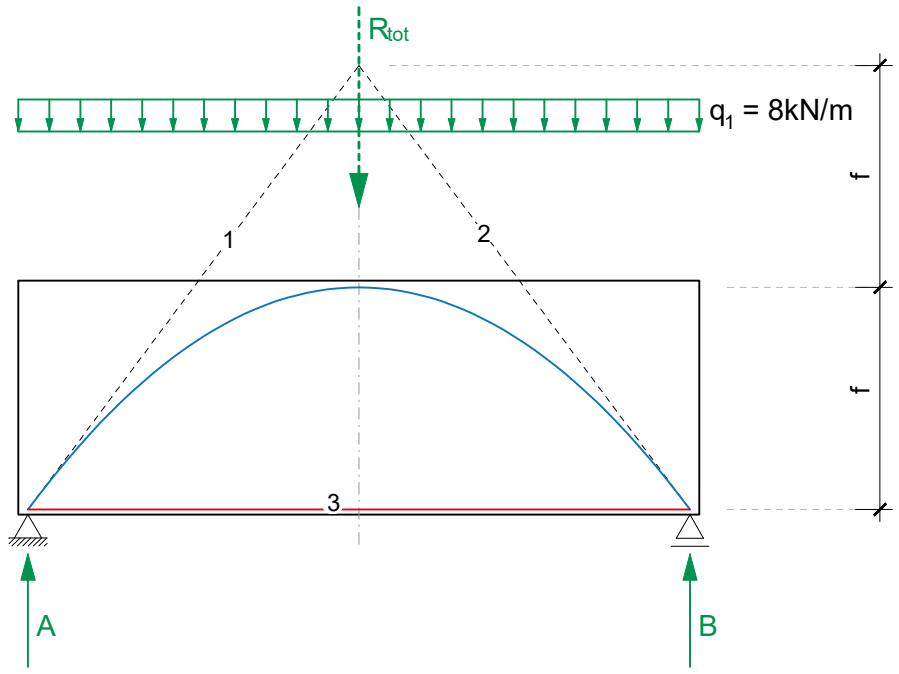


form diagram 1:100

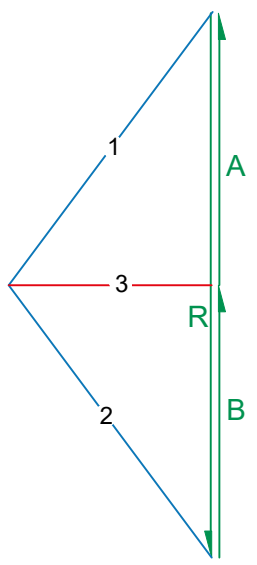


force diagram 1cm ≙ 10kN

b)

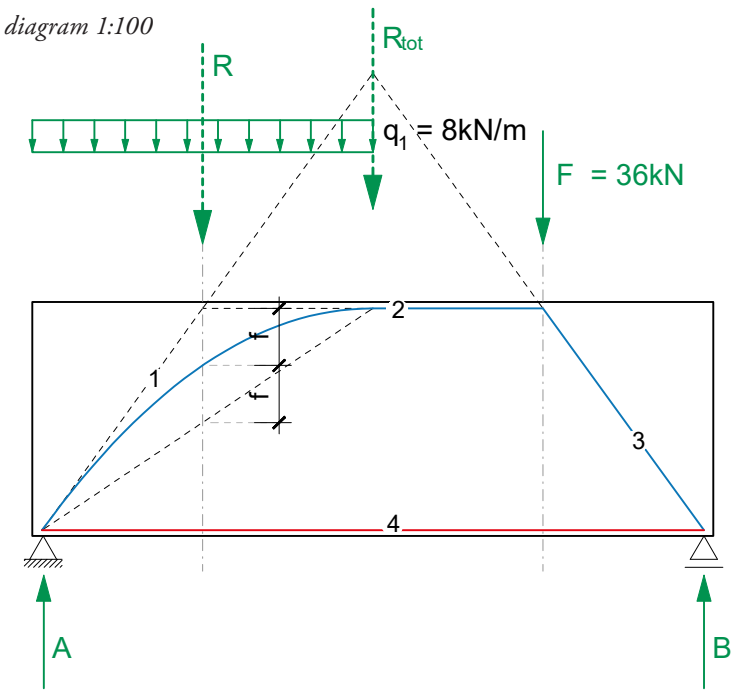


form diagram 1:100

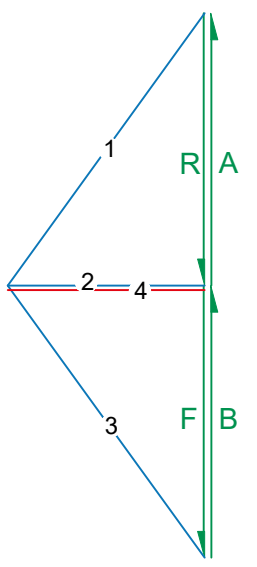


force diagram 1cm ≙ 10kN

c)

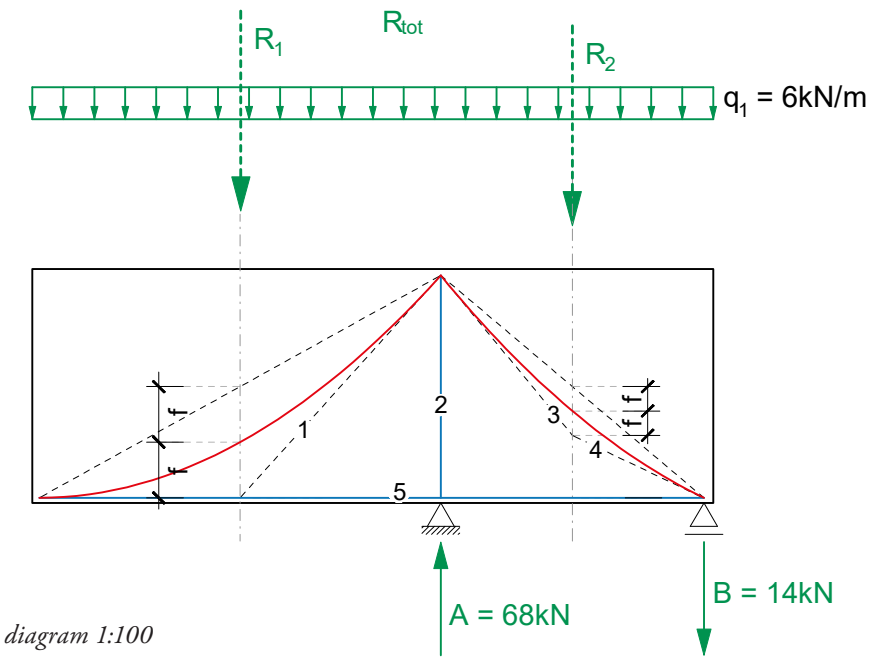


form diagram 1:100

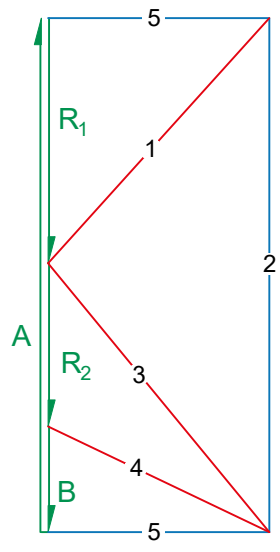


force diagram 1cm ≙ 10kN

d)



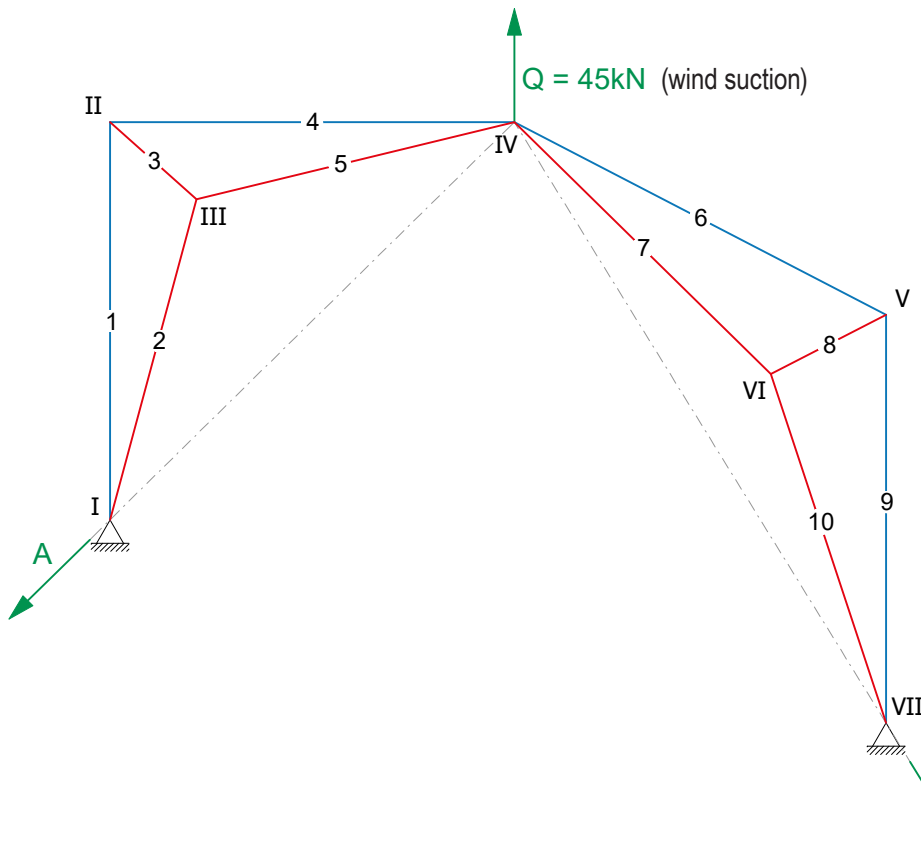
form diagram 1:100



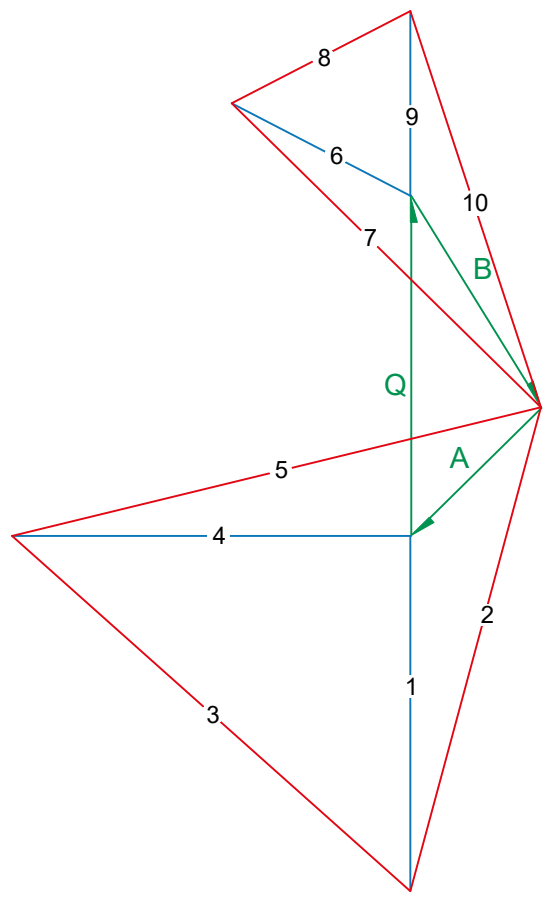
force diagram 1cm ≙ 10kN

Additional Task 2 — Three-hinged Arch

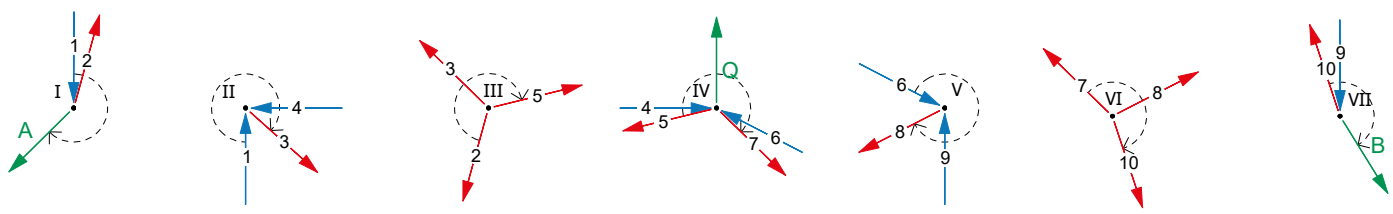
Determine the magnitude of the supporting reactions A and B and draw the corresponding force diagram.



form diagram 1:100



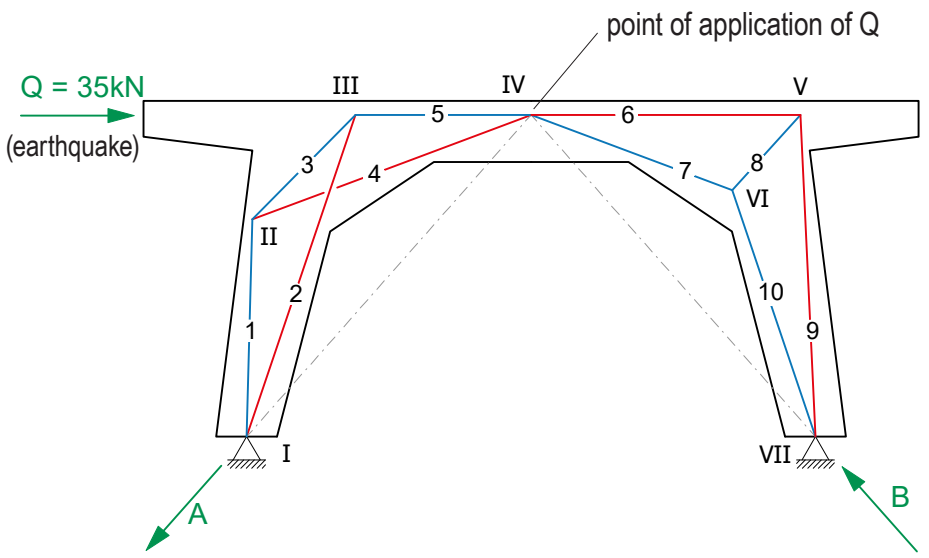
force diagram 1cm ≙ 10kN



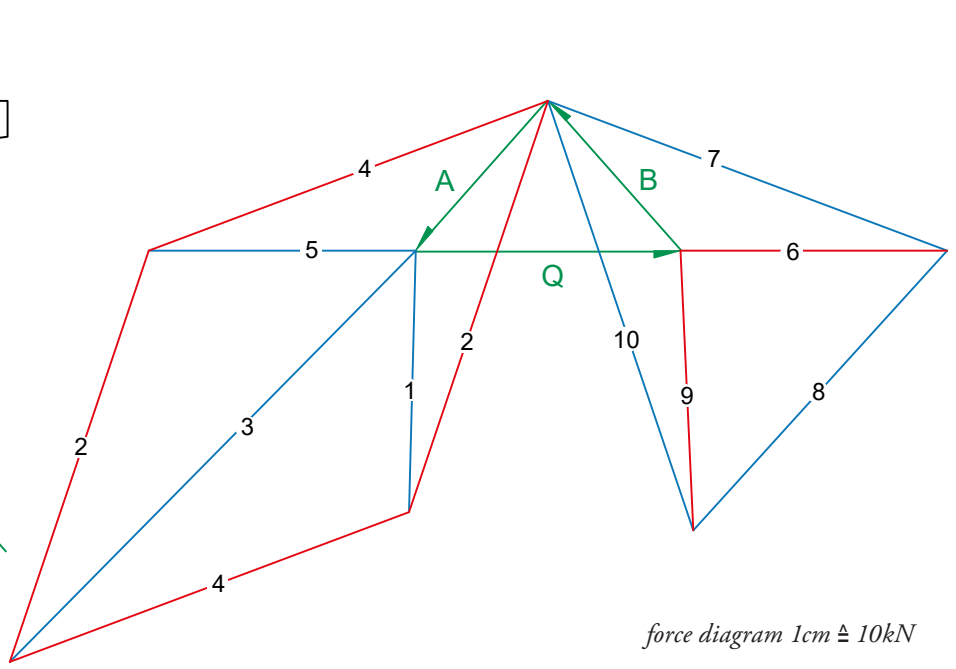
subsystem

Additional Task 3 — Reinforced Concrete Frame

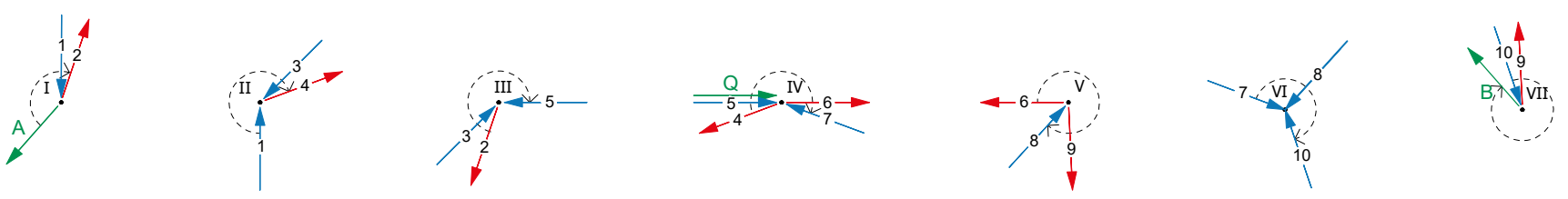
Given is the possible distribution of the internal forces for a reinforced concrete frame. Draw the corresponding force diagram. Indicate tension forces with red and compression forces with blue.



form diagram 1:100



force diagram 1cm ≙ 10kN



subsystem