Task 1 Estádio Municipal de Braga von Eduardo Souto de Moura

a) Over the two 55m wide terraces precast concrete panels are placed and fixed at the hanging cables. Every concrete panel with a width of b=3.7m and a materialthickness of d=240mm is fixed on two hanging cables. Calculate the uniform load g_d per cable at the measuring level and enter the value in kN/m. Room load reinforced concrete γ_k=25kN/m³

b) After a heavy snowfall the snow only remained on the northside of the roof whilst melted on the southside. This leads to asymmetrical load. Calculate the live load q_d. Area load snow q_k = 5.4 kN/m²

c) Find the static form of the hanging cable which spans between the supports A and B. The maximum cablestrength is 2‘454 kN. Draw the form and force diagram. How big are the reaction forces A and B?

d) Dimension the cross-section of the cable if steel S500 is used. Enter the diameter D rounded off to mm.

a) $A = l \cdot b = 3.7\ m \cdot 0.24\ m = 0.89\ m^2$
$g_k = A \cdot \gamma_k = 0.89\ m^2 \cdot 25\ kN/m^3 = 22.2\ kN/m$
$g_d = g_k \cdot \gamma_G = 22.2\ kN/m \cdot 1.35 = 30.0\ kN/m$
g_d pro Seil: 30.0 kN/m / 2 = **15 kN/m**

b) $q_k = \overline{q_k} \cdot l = 5.4\ kN/m^2 \cdot 3.7\ m = 20\ kN/m$
$q_d = q_k \cdot \gamma_Q = 20\ kN/m \cdot 1.5 = 30\ kN/m$
q_d pro Seil: 30.0 kN/m / 2 = **15 kN/m**

c) $R_L = g_d \cdot l = 15\ kN/m \cdot 55m = 825\ kN$
$R_R = g_d \cdot q_d \cdot l = 2 \cdot 15\ kN/m \cdot 55m = 1‘650\ kN$

d) $N_d = 2‘454\ kN$
$f_{td} = f_{tk} / \gamma_M = 500\ N/mm^2 / 1.05 = 476.2\ N/mm^2$
$A_{req} = N_d / f_{td} = 2‘454\ kN / 476.2\ N/mm^2 = 5‘153\ mm^2$
$D = \sqrt{4 \cdot A / \pi} = \sqrt{4 \cdot 5‘153\ mm^2 / \pi} = \mathbf{82\ mm}$

Form diagram 1:1000

R_L = 825 kN
R_R = 1‘650 kN
N_1 = 2‘129 kN
N_2 = 1‘915 kN
N_3 = 2‘454 kN
A = 2‘129 kN
B = 2‘454 kN

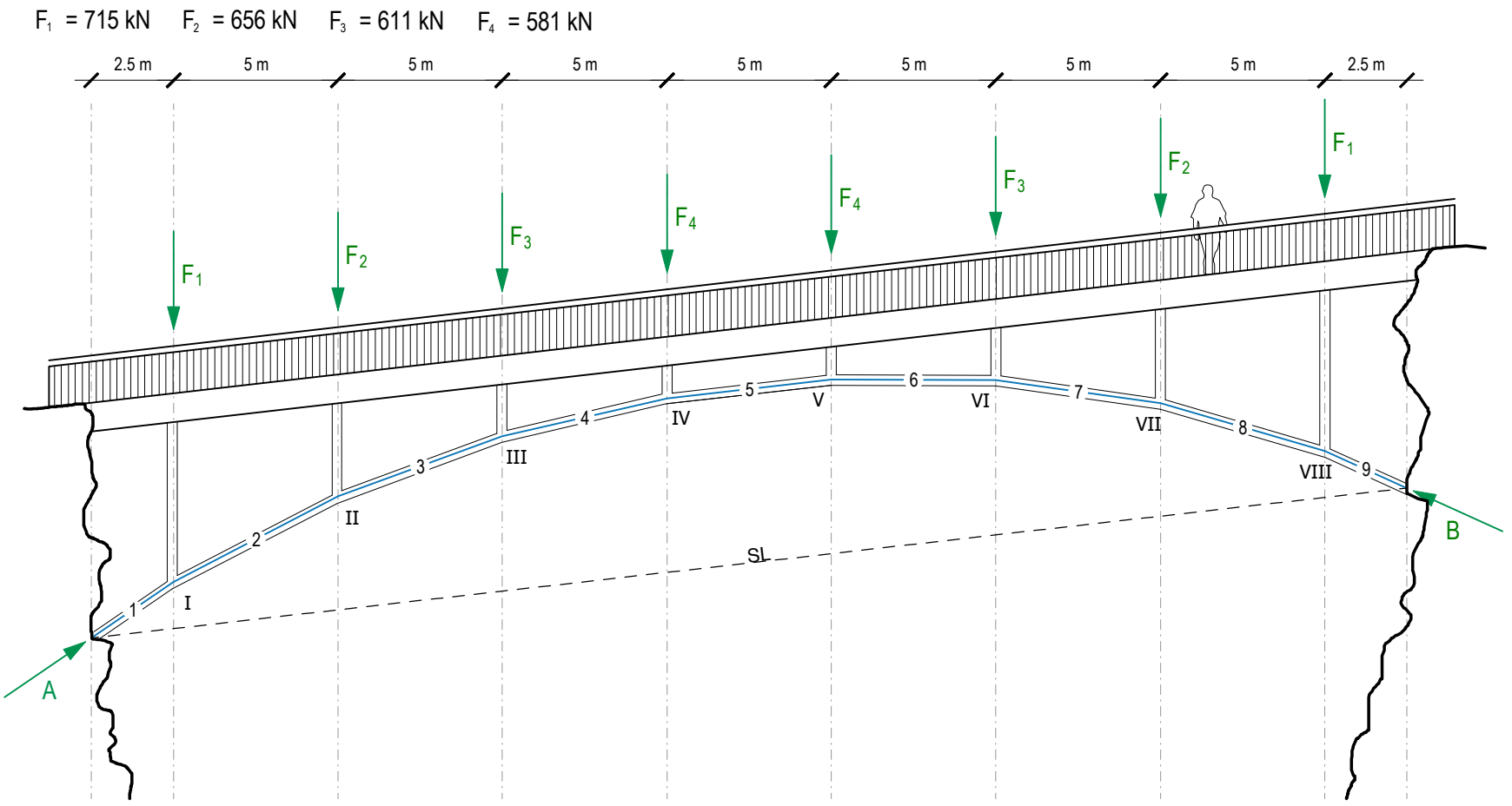
1 cm ≙ 200 kN

Force diagram

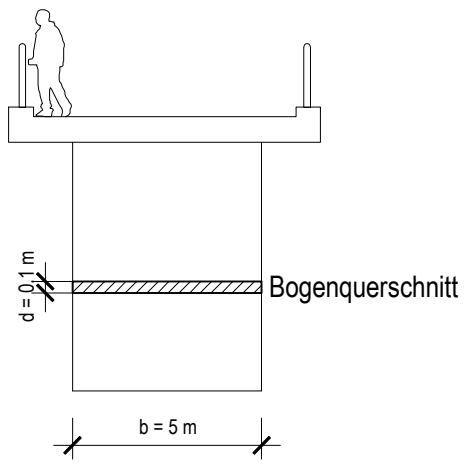
Task 2 Concrete arch bridge

a) Find the form of the concrete arch, if the material used is concrete C 16/20. The middle segment of the arch should be parallel to the deck. The dimensions of the arch's cross-section are: d=0.1m and b=5.0m. Calculate $N_{d,max}$ with a characteristic stress of fck =16 N/mm2 in compression and the resistance coefficient $\gamma_m = 1.5$.

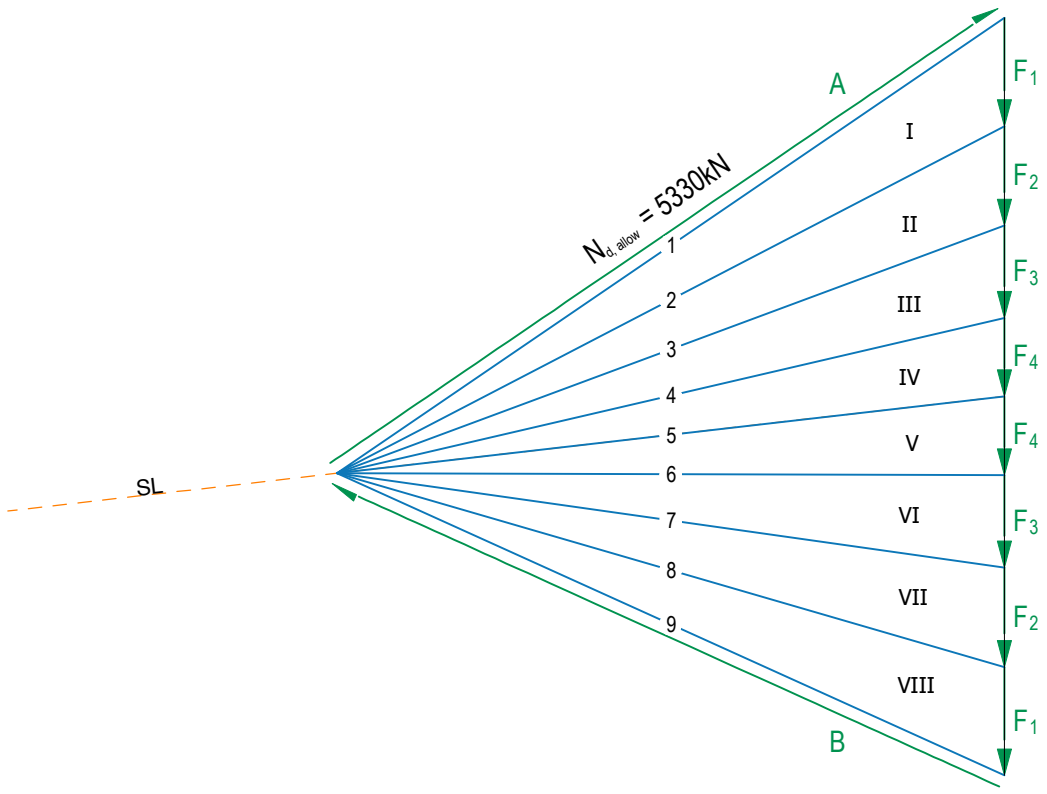
b) Find the funicular form of the arch in pure compression and give the size, location and direction of the reaction forces.



Form diagram 1:200



Section 1:200

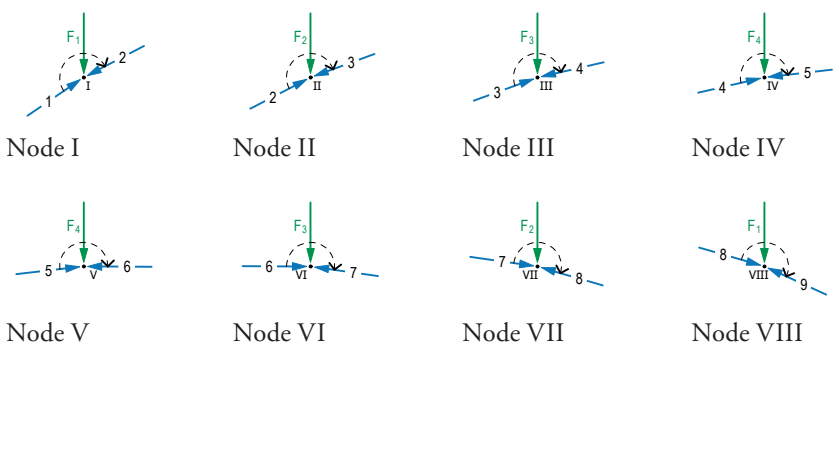


1 cm ≙ 500 kN

Force diagram

a)

A_{eff}	= b · d	= 5000 mm · 100 mm	= 500‘000 mm²
f_{cd}	= f_{ck} / γ_M	= 16 N/mm² / 1.5	= 10.66 N/mm²
$N_{d,allow}$	= f_{cd} · A_{eff}	= 10.66 N/mm² · 500‘000 mm²	= 5330 kN



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