

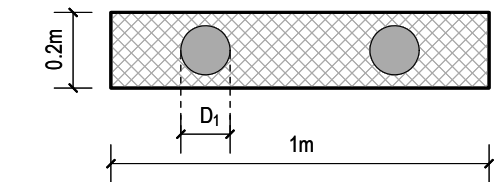
Task 1 Dimensioning of elements under tension

Given is the normal force  $N_d = 5900\text{kN}$ , which is distributed on several steel cables (steel S235) as shown in sections a) and b). (Assumption: the cables carry the full tension load, i.e. the stresses on the concrete can be neglected)

a),b) Calculate the minimum cable diameter D1 and D2 in steel S235 for the two cases shown in a) and b) (rounded to the next higher mm).  
The material values can be found in the formula sheet.

c) What could possible advantages and disadvantages of constellations a) and b) be? Specify your favorite choice and justify it.

Option 1.1



Cross Section 1:20

$N_d$

=

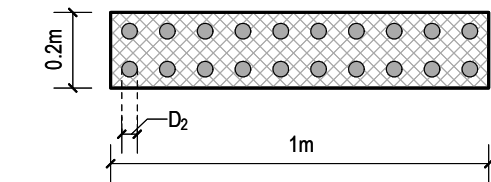
$f_{tk}$

=

$\gamma_M$

=

Option 1.2



Cross Section 1:20

$N_d$

=

$f_{tk}$

=

$\gamma_M$

=

b)

Task 2 Different materials in tension and compression

To get a sense of how different materials behave in tension and compression, we compare the behavior of timber (spruce), steel (S235) and concrete (C20/25).

a) Refer to the formula sheet to find the characteristic values for tensile and compressive strengths, and the safety factors for each material and introduce them into the table.

b) Consider a tensile stress of  $N_d = 12\text{kN}$ . Calculate for the three materials the required square crosssectional area  $A_{req}$  and side length  $a$  required for  $N_d$ .

c) Repeat b) now with a compressive load of  $N_d = 12\text{kN}$ .

a)

	Wood Spruce	Steel S235	Concrete C20/25
$\gamma_M$			
$f_{tk}$			
$f_{td}$			
$f_{ck}$			
$f_{cd}$			

b) Wood

$N_d$

=

12'000 N

$f_{td}$

=

Steel

$N_d$

=

$f_{td}$

=

Concrete

$N_d$

=

$f_{td}$

=

c) Wood

$N_d$

=

-12'000 N

$f_{cd}$

=

Steel

$N_d$

=

$f_{cd}$

=

Concrete

$N_d$

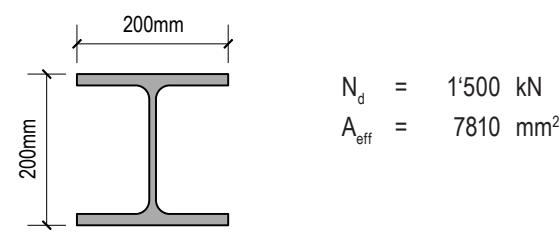
=

$f_{cd}$

=

Task 3 Stress check

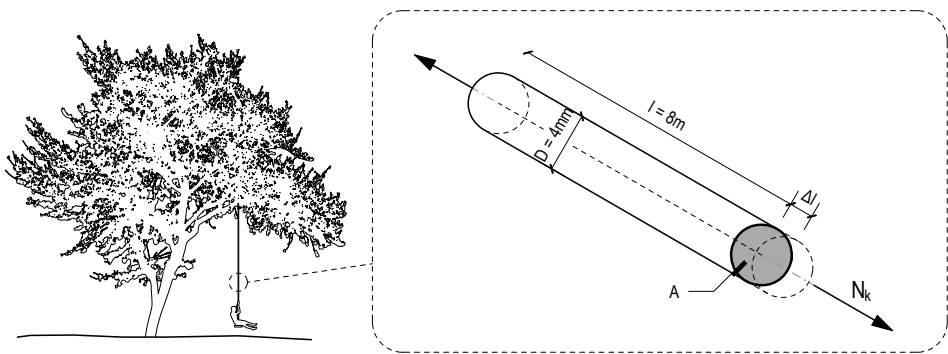
Find the stresses for the steelprofile for the given values.



Cross Section 1:10

Task 4 Deformation

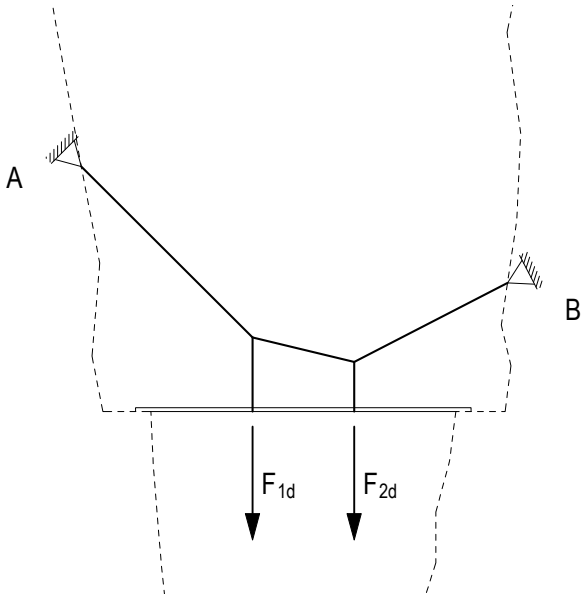
You hang a swing from a tree with thin steel cable S235 with a length  $l = 8\text{m}$  and diameter  $D = 4\text{ mm}$ . Assuming that the person on the swing weighs  $80\text{ kg}$ , find the change in length of the cable in  $\text{mm}$  and in  $\Delta l\%$ .



Task 5 Deformation

- a) Draw the force diagram for the hanging bridge and enter the force in the main cable. Calculate the rope diameter and the change in length due to the stress for the member made of steel S235. Specify both the change in length  $\Delta l$  and the percentage of change in length  $\%$ .  
 $F_{1d} = F_{2d} = 40\text{ kN}$ .
- b) Describe how the change in length could affect the position and force diagrams.

a)



Form Diagram 1:1'000

Node I

Node II

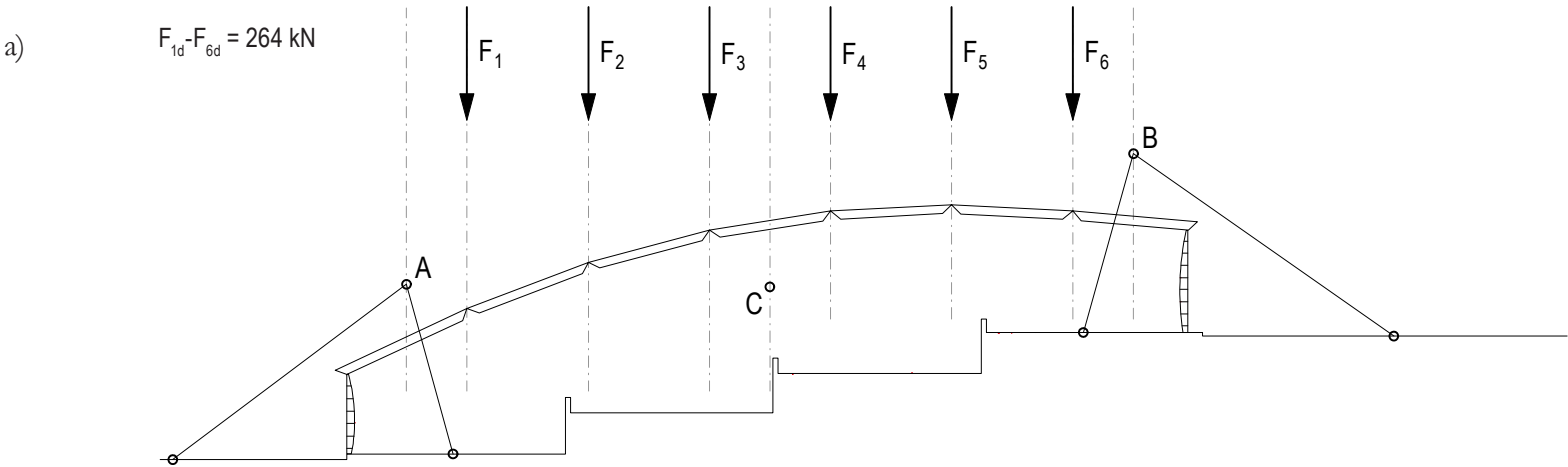
FBD

1 cm  $\hat{=}$  10 kN

Force diagram

b)

Task 6    Dimensioning step by step



Form Diagram 1:500

Node I

Node II

Node III  
FBD

1 cm  $\hat{=}$  300 kN  
Force Diagram

b)    Starting position:

Formula:

Add values:

Calculate:

Steelprofile:

c)    Starting position:

Formula:

Add values:

Calculate:

Compare stresses: