EX 1

Structural Design I – HS 22

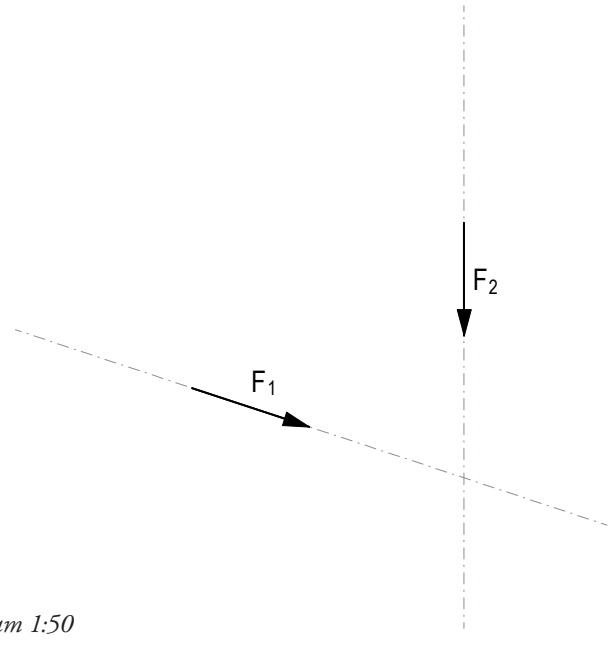
Equilibrium

Name:

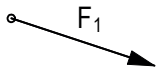
Koje:

Task 1 Resultant of two non-parallel forces

For the given loading case, find the magnitude and direction of the resultant in the force diagram as well as its position in the form diagram. Draw the applied forces as well as the resultant in green.



F_1 = 20 kN
F_2 = 30 kN

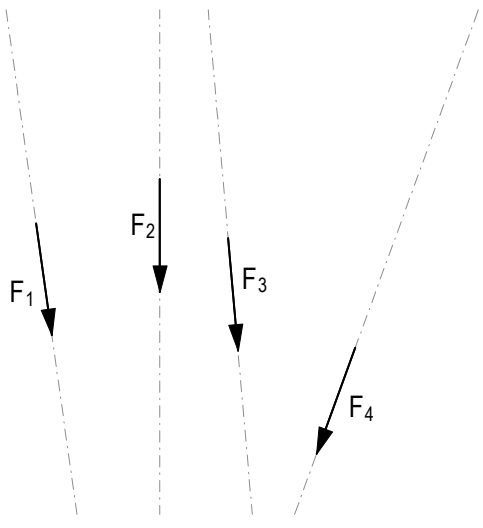


form diagram 1:50

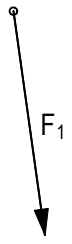
force diagram 1cm ≙ 10kN

Task 2 Resultant of several non-parallel forces

Find the magnitude and direction of the resultant in the force diagram as well as its position in the form diagram by using a trial funicular. Draw the applied forces as well as the resultant in green.



F_1 = 45 kN
F_2 = 30 kN
F_3 = 15 kN
F_4 = 30 kN

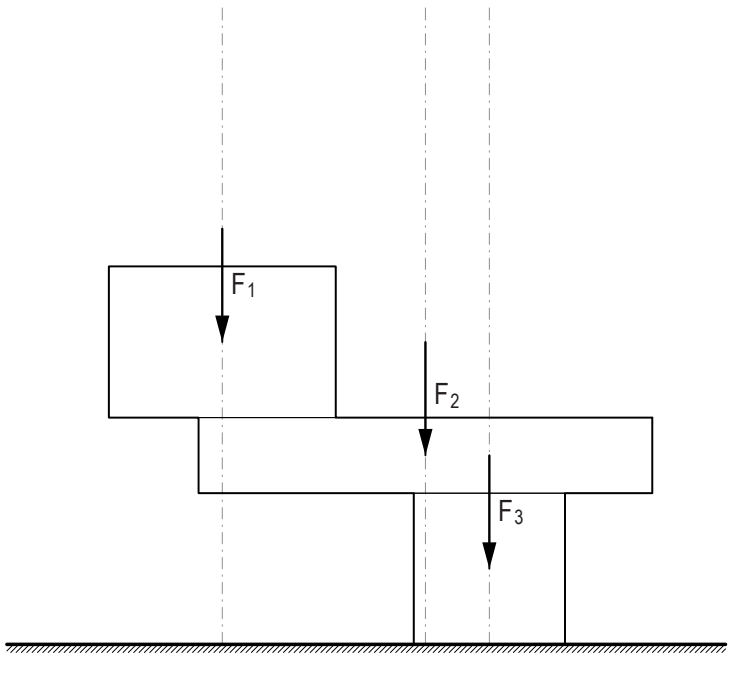


form diagram 1:50

force diagram 1cm ≙ 15kN

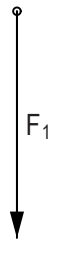
Task 3 Resultant of several parallel forces

Given is a sculpture of stacked steel boxes. Each acting force corresponds to the weight of one box. Find the magnitude and the direction of the resultant in the force diagram as well as its position in the form diagram by using a trial funicular and check whether the arrangement is stable. Note: The boxes are welded together but not fixed on the ground.



F_1 = 60 kN
F_2 = 60 kN
F_3 = 40 kN

☐ stable
☐ not stable



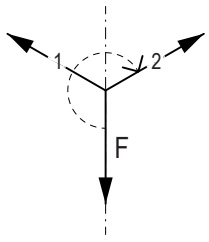
form diagram 1:50

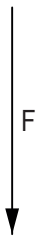
force diagram 1cm ≙ 20kN

Task 4 Single node equilibrium

Draw the corresponding force diagram for each subsystem (a-f) for F = 30 kN. Determine the magnitude [kN] of each force and mark its direction in the subsystem. Indicate tension forces with red, compression forces with blue and external forces with green. Explain the solution of situation e).

a)





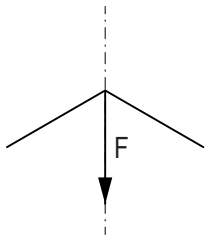
subsystem

N_1 [kN]	N_2 [kN]

force diagram
1cm ≙ 10kN

☐ ☐ compression
☐ ☐ tension

b)



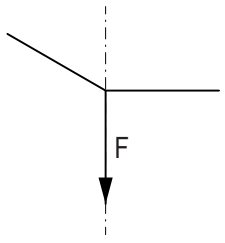
subsystem

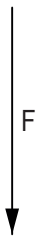
N_1 [kN]	N_2 [kN]

force diagram
1cm ≙ 10kN

☐ ☐ compression
☐ ☐ tension

c)





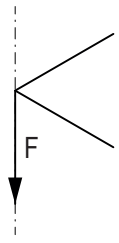
subsystem

N_1 [kN]	N_2 [kN]

force diagram
1cm ≙ 10kN

☐ ☐ compression
☐ ☐ tension

d)



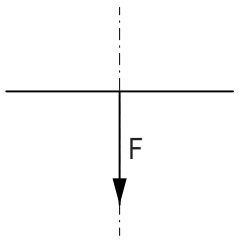
subsystem

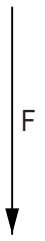
N_1 [kN]	N_2 [kN]

force diagram
1cm ≙ 10kN

☐ ☐ compression
☐ ☐ tension

e)





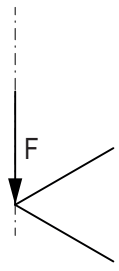
subsystem

N_1 [kN]	N_2 [kN]

force diagram
1cm ≙ 10kN

☐ ☐ compression
☐ ☐ tension

f)



subsystem

N_1 [kN]	N_2 [kN]

force diagram
1cm ≙ 10kN

☐ ☐ compression
☐ ☐ tension

Explanation for e):

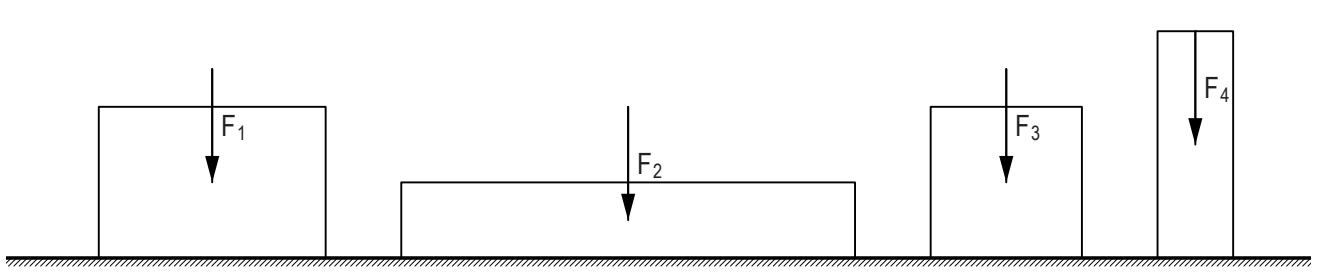
Creative Task

Resultant and Stability: Stacking of boxes

Stack the given steel boxes on top of each other and check whether your stack is stable. Assume that the boxes are being welded together. The given boxes should not be rotated.

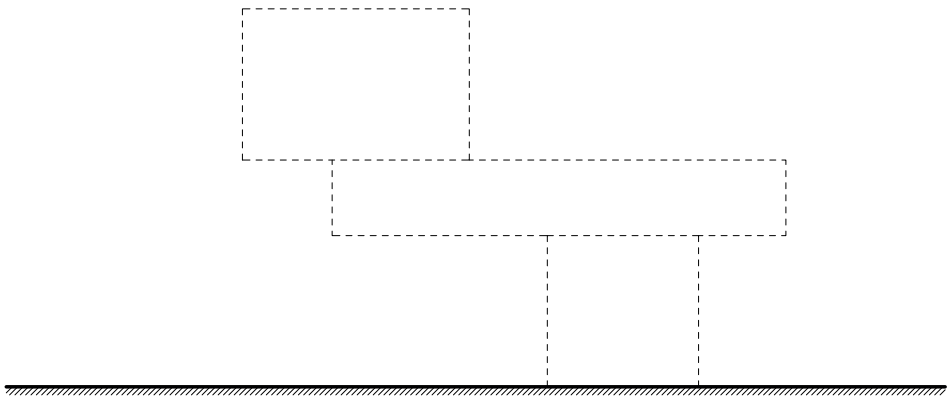
a) Change the arrangement from task 3) with the help of the force diagram so that it becomes stable.

b) Design your own interesting arrangement of 4 boxes that challenges your sense of balance but is stable. Check the stability of your arrangement with the help of the force diagram.



F_1 = 60 kN
F_2 = 60 kN
F_3 = 40 kN
F_4 = 30 kN

a)



form diagram 1:50

force diagram 1cm ≙ 20kN

b)

form diagram 1:50

force diagram 1cm ≙ 20kN