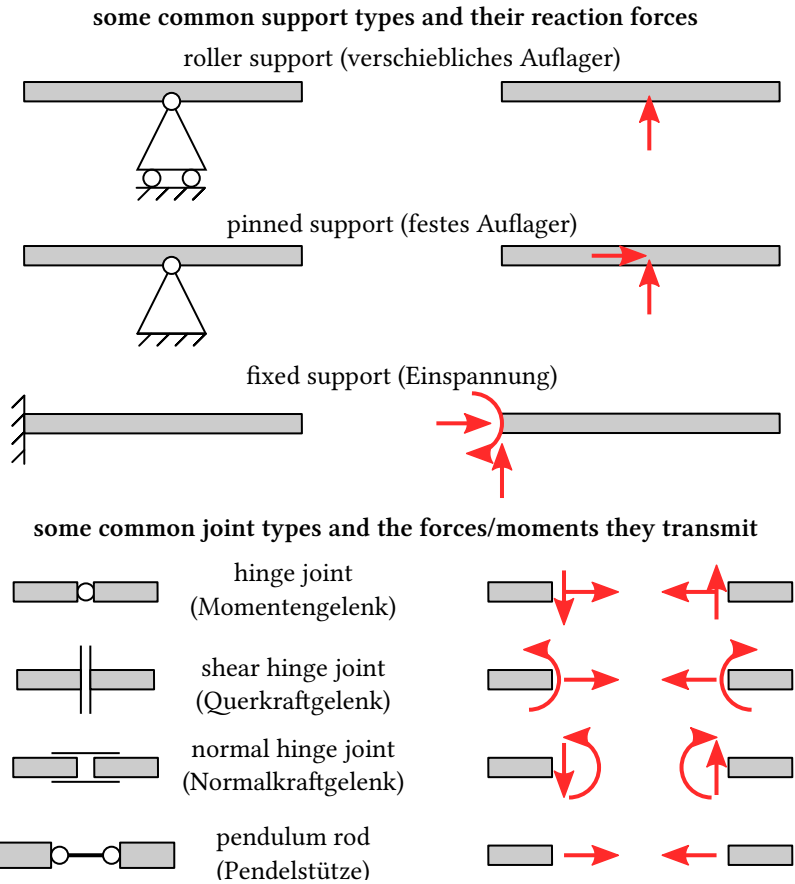# Exercise 2: Basic structural mechanics
25.10.2024 - 01.11.2024

This exercise deals with elementary concepts in structural mechanics. Below is a short reminder of common supports and joint types, which may be useful in this context.

some common support types and their reaction forces

roller support (verschiebliches Auflager)

pinned support (festes Auflager)

fixed support (Einspannung)

some common joint types and the forces/moments they transmit

hinge joint
(Momentengelenk)

shear hinge joint
(Querkraftgelenk)

normal hinge joint
(Normalkraftgelenk)

pendulum rod
(Pendelstütze)

Recall that a $2D$ structure is statically determinate if

$$3n - (r + v) = 0,$$

where n is the number of bodies, r the number of reaction forces or moments of the supports, and v the number of forces or moments transmitted at links. If this sum is greater than zero, then the system has unconstrained degrees of freedom, i.e. it can move. If the sum is less than zero, then the system is statically indeterminate. Keep in mind degenerate cases, which were discussed in class!
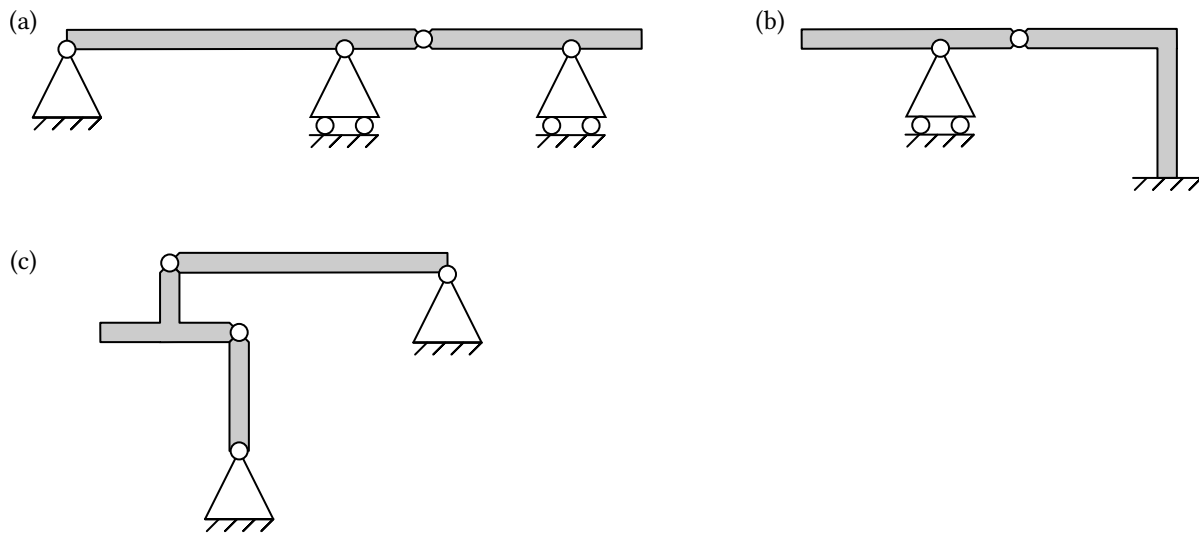
Question 1 ....
Are the following systems statically determinate? Which of these are over- or underconstrained?
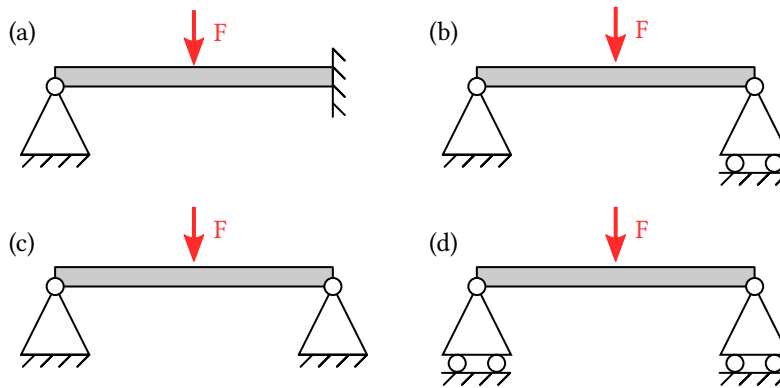
Question 2 ....
For the structure below, calculate the reaction forces, as well as the internal forces and moments. Note that the positive y-direction points out of the plane of the paper.
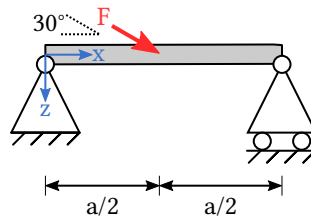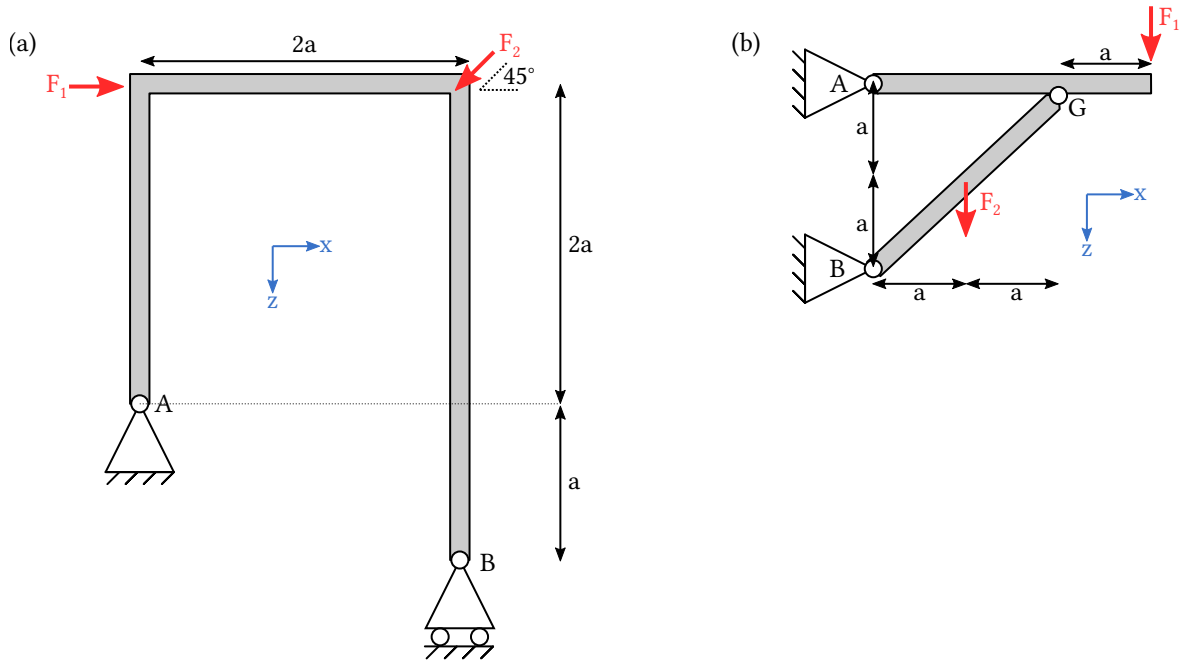

Question 3 ....
Check whether the following systems are statically determinate! Note that they contain hinges.

Question 4 . . . .

For the two problems below you should (i) check whether they are statically determinate, and (ii) calculate the reaction forces at the supports. Use the indicated coordinate system (blue)! Note that the positive y-direction points out of the plane of the paper. *Hint:* problem (b) is slightly more complicated than (a) because here the structure consists of two bars, not one. Cut the structure at the hinge G, and write the equilibrium conditions for the bars A-G and B-G separately. Don't forget the two forces that are transmitted at the hinge when you make the cut! You can afterwards check your solution by considering the equilibrium conditions for the complete structure.

(a)

(b)

Question 5 . . . .

Sketched below is a GERBER girder. Check that the problem is statically determinate, calculate the reaction forces and finally calculate the internal forces and moments. Use the indicated coordinate system (blue)! Note that the positive y-direction points out of the plane of the paper. *Hint:* like in question 4(b) you can determine all reaction forces only if you consider equilibrium conditions separately for the two bars.