CM01 – Concrete and Masonry Structures 1
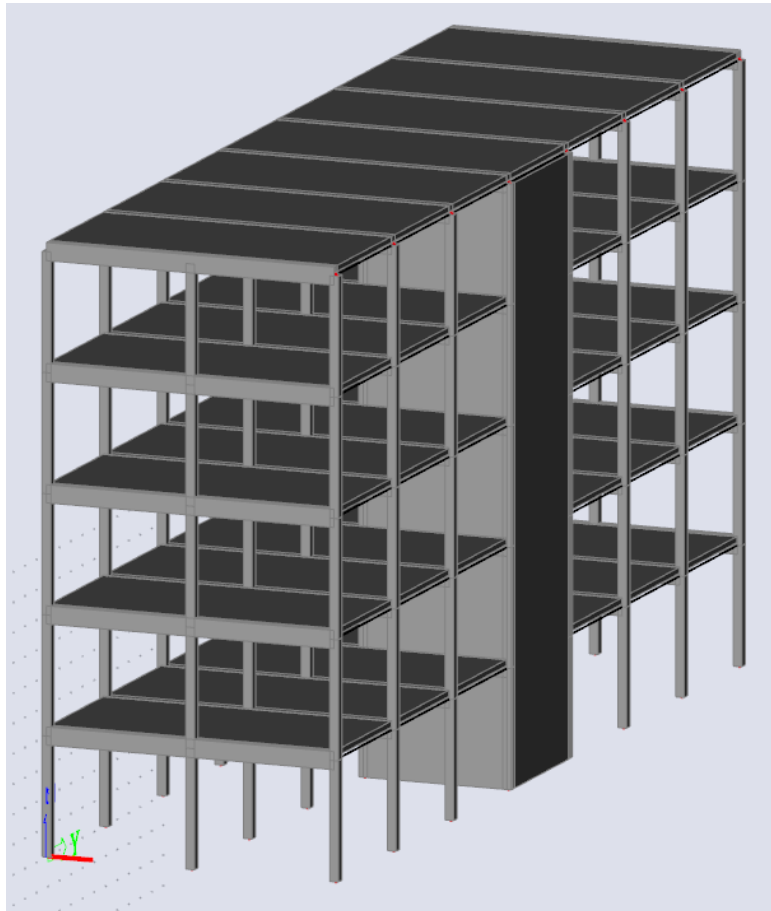
HW1 – Preliminary design of frame structure

Short (homework overview)

Task 1

Task 1 – Frame structure

In Task 1, a frame structure will be designed.
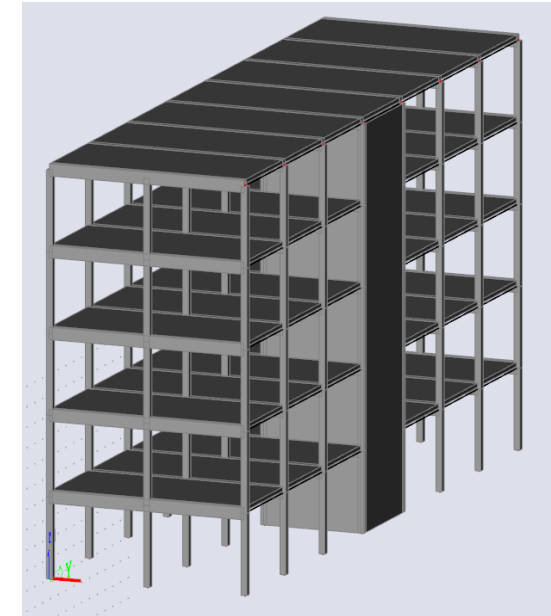
Task 1 – Assignment

Geometry: R, a [m] – horizontal dimensions, h [m] – floor height, n – number of floors

Materials: Concrete – **concrete class**
             Steel B 500 B (f_{yk} = 500 MPa)

Loads: Other permanent load of typical floor $(g-g_0)_{floor,k}$ [kN/m²]
             Other permanent load of the roof $(g-g_0)_{roof,k}$ [kN/m²]
             Live load of typical floor $q_{floor,k}$ [kN/m²]
             Live load of the roof $q_{roof,k}$ = 0,75 kN/m²
             Self-weight of the slab $g_{0,k}$ (calculate from the slab depth)
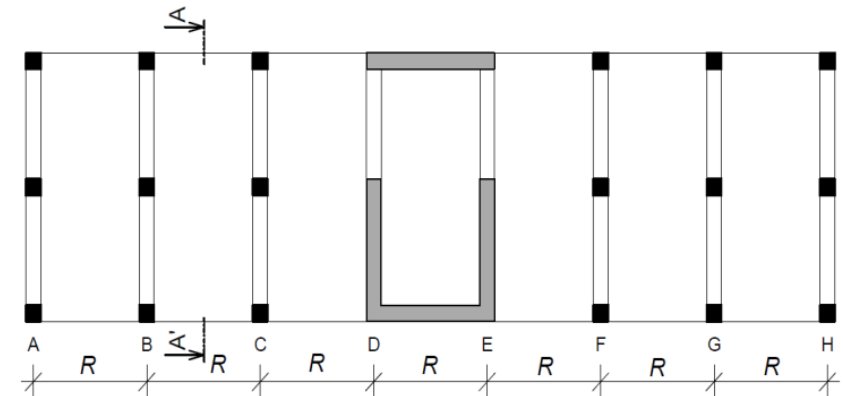
Another parameters: S – Exposure class related to environmental conditions
                      Z – Working life of the structure

Parameters in bold are individual parameters, which you can find on the course website.

Your individual parameters:
https://docs.google.com/spreadsheets/d/1uQIuyyKEcG5jaZVLrsmm1ZRRNib_ow3MI
wgZSEDgnW8/

Task 1 – Assignment goals
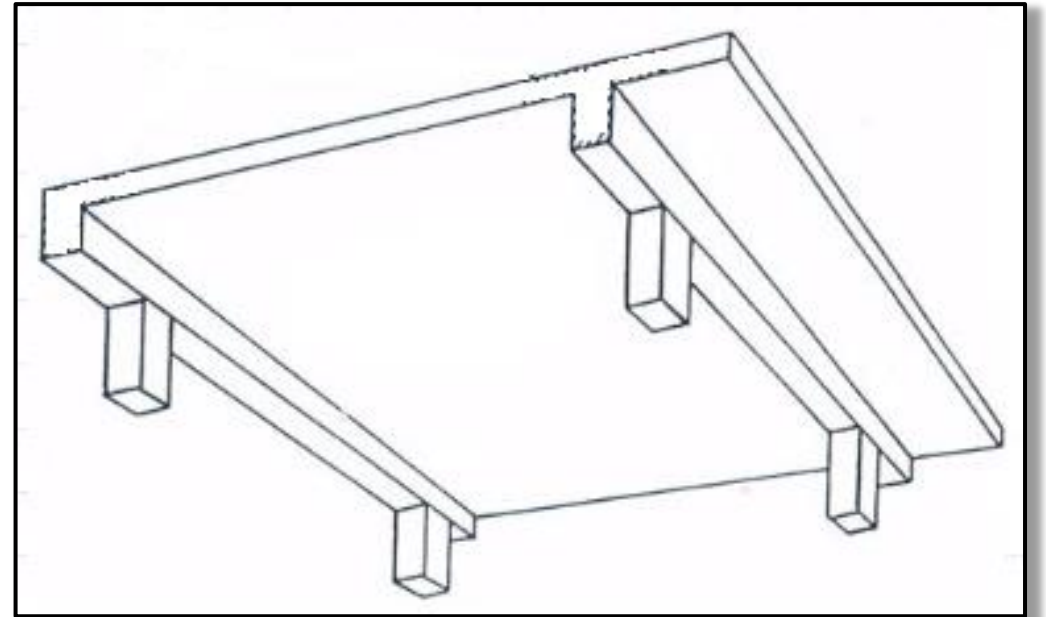
Our goal will be to:
- **Design the dimensions** of all elements.
- Do detailed **calculation of 2D frame** – calculation of bending moments, shear and normal forces using FEM software.
- **Design steel reinforcement** in the members.
- **Draw layout** of the reinforcement.

Task 1 – part 1

Task 1 – part 1

In this seminar, we will **design dimensions of all structural members** – i.e.:
- depth of the **slab**,
- cross-sectional dimensions of the **beam**,
- cross-sectional dimensions of the **column**.

We will also do a **sketch of the structure**.

Slab

For the slab, we will:
- **Design the depth** (thickness) of the slab **using a simple empirical equation**.
- Calculate the **concrete cover** and the **effective depth**.
- **Assess the span-to-depth** ratio.
    - (If necessary: **Adjust the slab depth**.)
- Calculate the **slab load**.

Beam

For the beam, we will:
- Design the **width and height** of the beam cross-section.
- Calculate the **concrete cover** and the **effective depth**.
- Calculate the **beam load**.
- Estimate the **maximal internal forces**.
- Check the ξ (x/d) **ratio**.
  - (If necessary: **Adjust the beam width/height**.)
- Check the **reinforcement ratio**.
  - (If necessary: **Adjust the beam width/height**.)
- Check the **maximal load-bearing capacity in shear**.
  - (If necessary: **Adjust the beam width/height**.)
- **Assess the span-to-depth** ratio.
  - (If necessary: **Adjust the beam width/height**.)

Column

For the column, we will:
- Calculate the **column load**.
- Calculate the **required cross-sectional area**.
- Design the **width and height** of the column cross-section.

Sketch of the structure

After designing the dimensions of all the elements, we have to make a **sketch of the structure**. The sketch must include:
- **plan view** of the structure (at least 2 fields in each direction),
- the **edges** of columns, beams and slabs,
- plan **dimensions**,
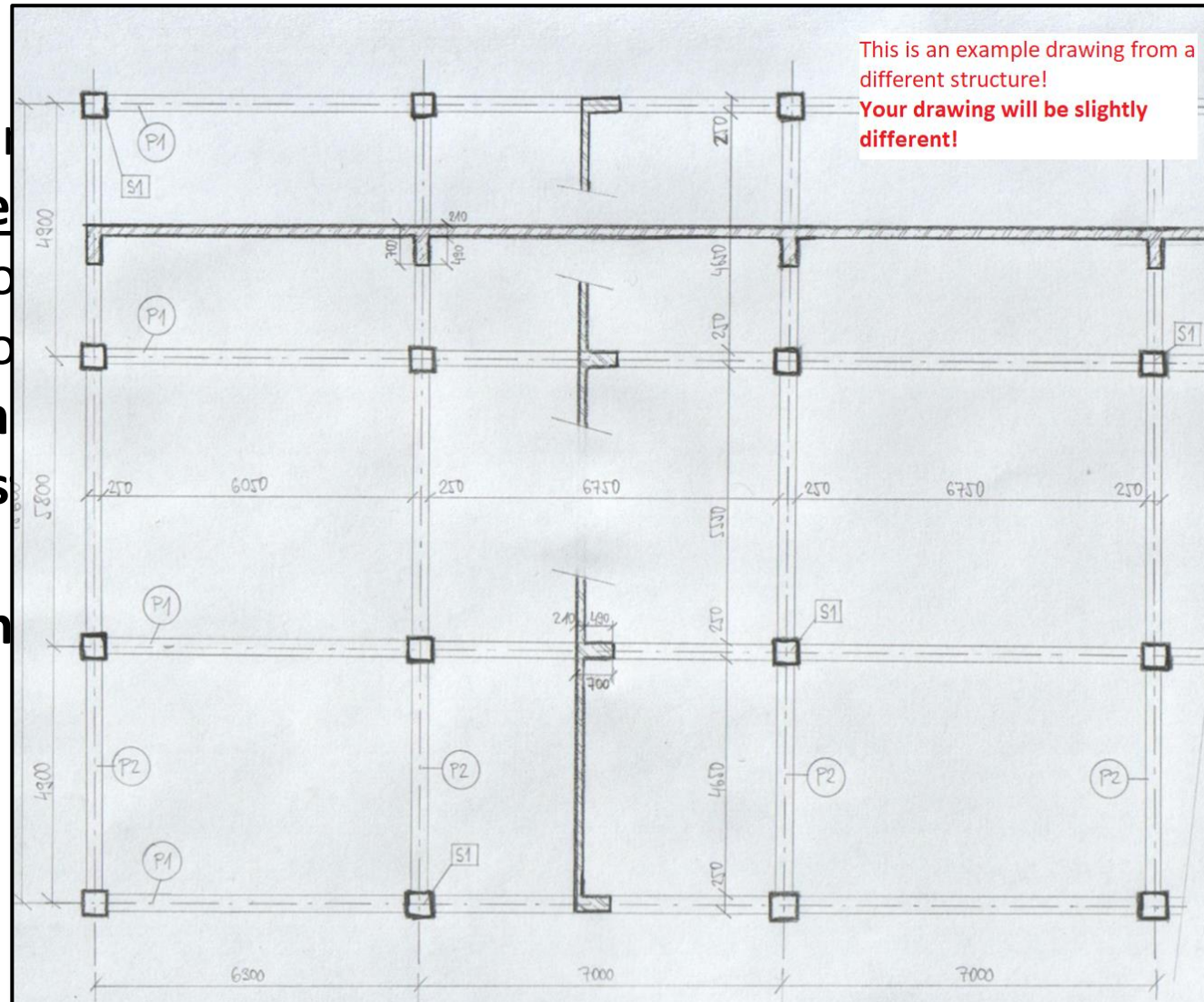- **cut of the structure** perpendicular to the beams.

The sketch must show all designed dimensions of the elements.

Sketch of the structure

After designi... make a **sketch of the structure**
- **plan view** o...
- the **edges** o...
- plan **dimen**...
- **cut of the s**...

The sketch m...

Next week

Next week we will focus on detailed **calculation of internal forces using FEM software**.

Are you able to use any Finite Element Analysis software?

If not, **apply for [student license](#)** for the **SCIA Engineer software**.
When applying, **use your school student email** (e.g., "name.surname@estp.fr").

thank you for your attention