Concrete and Masonry Structures 1 (133CM01)

Task 1: Frame structure

Figure 1 – Structure visualization

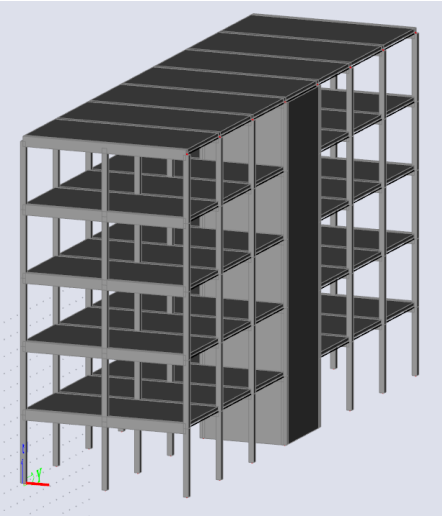


Figure 2 – Structure section A-A'

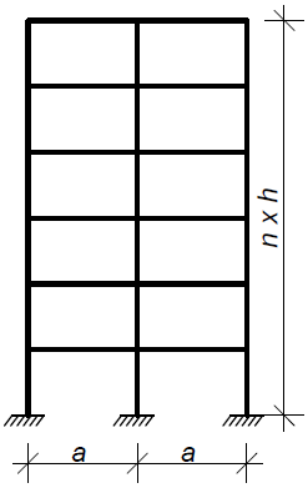
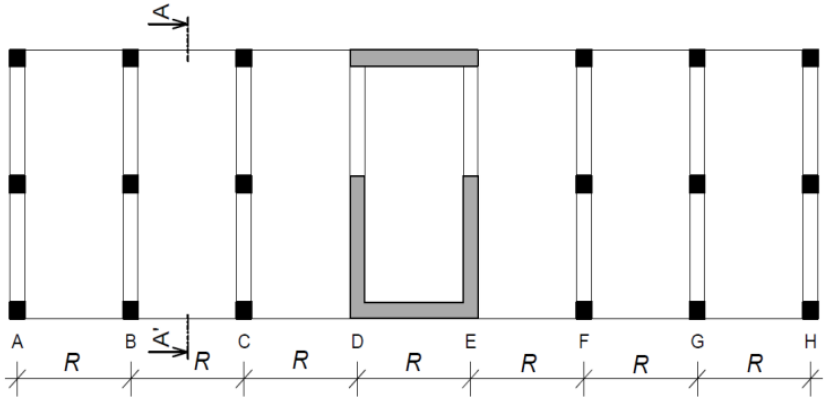


Figure 1 – Structure floor plan



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	$\boldsymbol{(g\text{-}g_0)_{floor,k}}$ [kN/m^2]
	Other permanent load of the roof	$\boldsymbol{(g\text{-}g_0)_{roof,k}}$ [kN/m^2]
	Live load of typical floor	$\boldsymbol{q_{floor,k}}$ [kN/m^2]
	Live load of the roof	$q_{roof,k}$ = 0,75 kN/m^2
	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.

Assignment: Do the following work:

1. **Design the dimensions of the structure** (slab depth, dimensions of the beam, dimensions of the column) and **sketch** the structure's floor plan and designed dimensions**.**
3. **Structural analysis**:
   - Check of dimensions of the beam from the preliminary design.
   - Calculate bending moments, shear forces and normal forces in the frame using a suitable software.
   - Design the reinforcement of the bottom frame (beam and column).
4. **Reinforcement drawing of the bottom frame**.

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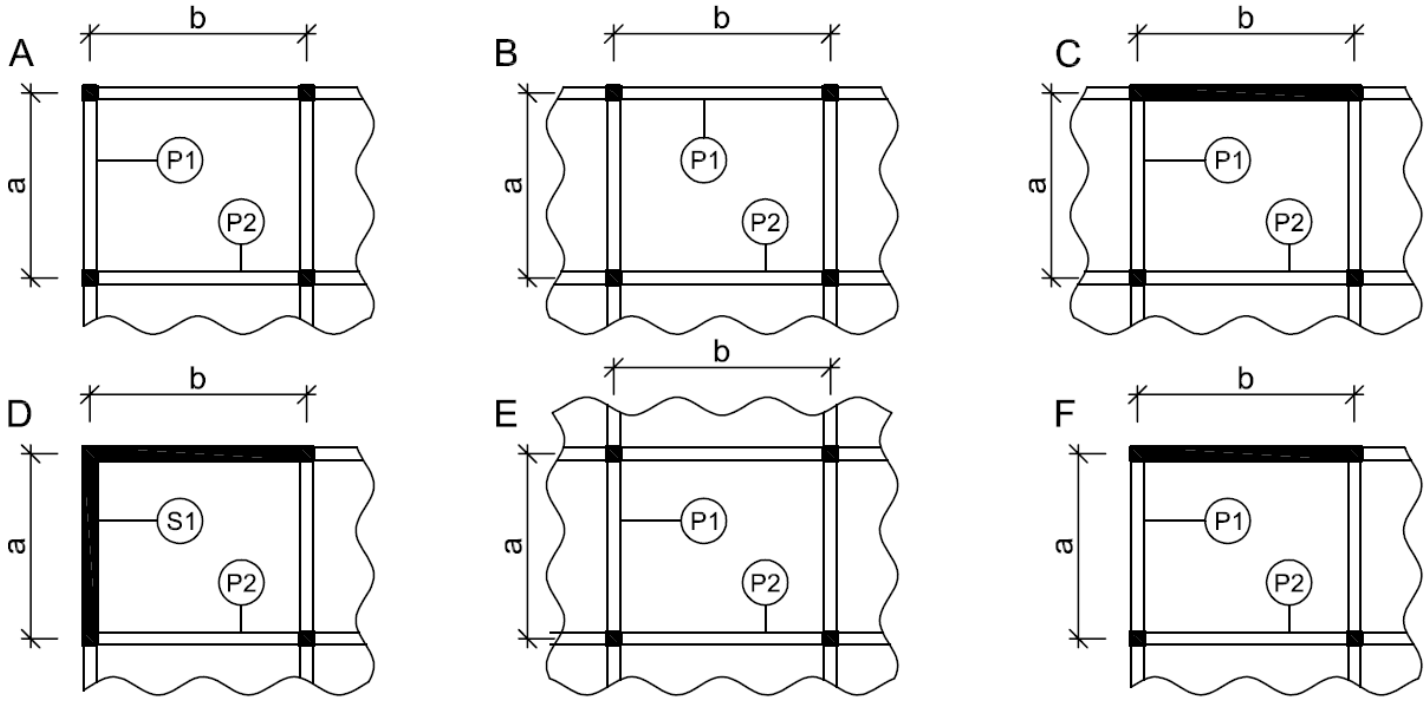
Task 2: Two-way slab supported on four sides

Consider a reinforced concrete structure of multi-floor building composed of walls, columns and continuous slabs. All spans of the slab are supported by walls or rigid beams on four sides. There are no openings in the slab.

Schemes of the structures:



Individual parameters (parameters in **bold** you can find on teacher‘s website):

Scheme: given **scheme**, given **beam (P) or wall (S)**

Geometry: ***a, b*** [m] – horizontal dimensions of the structure (***a*** see 1st task), $\boldsymbol{h_s}$ [mm] – depth of the slab

Materials: **see 1st task**

Loads: **see 1st task**, values for typical floor (except the self weight, which will be different)

Please work out:

1. **Calculation of bending moments in the slab**:
   a) Using linear analysis (i.e. do not consider the effect of torsion moments caused by prevented lifting of the corners of the slab). Proceed from the assumption that the deflections in *x* and *y* directions are equal.
   b) Using the precalculated tables based on the theory of plasticity (effect of torsion moment is included).
2. **Check the given depth of the slab** – use the bending moments from 1b). If the slab depth is not suitable, propose an adjustment.
3. **Calculation of the loading of a given beam or wall.**

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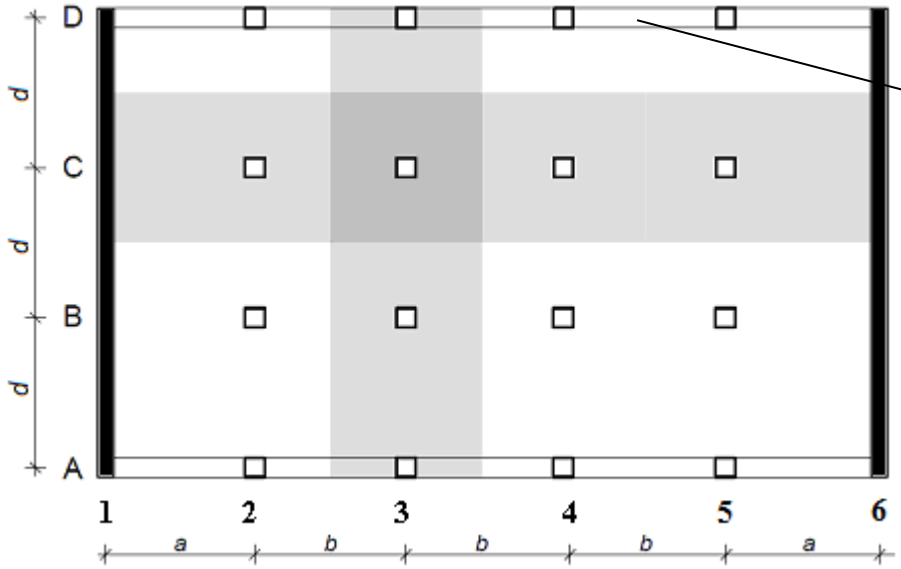
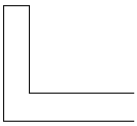
Task 3: Two-way slab supported on columns

Two-way slab supported on columns, edge beam in axes A and D, walls in axes 1 and 6.

Scheme of the structure:





Parapet beam – choose dimensions in the following ranges:
width 200 – 250 mm,
height 800 – 1000 mm.

Individual parameters (parameters in **bold** you can find on teacher‘s website):

Geometry: ***a, b, d*** [m] – horizontal dimensions of the structure (***a*** see 1st task, ***b*** see 2nd task), ***n –*** number of floors (see 1st task)

Materials: **see 1st task**

Loads: **see 1st task**, values for typical floor (except the self-weight, which will be different)

Please work out:

1. **Design of the dimensions of the load-bearing elements** (slab, columns). Choose the thickness of the wall as 200 mm or 250 mm.
2. **Sketch of the structure.**
3. **Structural analysis of the slab**:
   - Bending moments in strips C and 3 using the *Direct design method*.
   - Draw moment curves for both strips.
   - Design slab reinforcements (rebars) for the calculated moments.
   - Design the punching reinforcement for column C3.
4. **Layout of reinforcement** (separately for upper and lower layer of reinforcement).

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Task 4: Reinforced concrete stiffening walls

For the structure from Task 3, design sufficient number of reinforced concrete stiffening walls in the longitudinal direction (stiffening in transversal direction is already provided by the exterior walls in rows 1 and 6).
Design the stiffening walls so that there is no tension in the foot of the walls when characteristic wind load and minimum vertical load is applied.

Individual parameters (parameters in **bold** you can find on teacher‘s website):

T – Terrain category
W – Wind load area
h [m] – floor height (see 1st task)
n – number of floors (see 1st task)

Please work out:

1. **Design of geometry** (number and positioning of the walls)
2. **Sketch of reinforcement** for a selected wall

Task 5: Reinforced concrete staircase

Design a staircase for the structure from Task 1. Staircase will be supported by the reinforced concrete core. Adjust the span of the core if necessary (the distance between axes D and E need not to be equal to *R*).

Please work out:

1. **Design of dimensions of a reinforced concrete staircase** (including details of flight-landing connections)
2. **Design of staircase reinforcement**.
3. **Sketch of staircase reinforcement**.

Task 6: Pad footing

Design a footing for the inner column of the frame from Task 1. Use the resistance of the soil R_d = 400 kPa.

Please work out:

1. **Plain concrete footing.** Sketch of the footing shape.
2. **Reinforced concrete footing**. Drawing of the shape of the footing and layout of reinforcement including list of reinforcement.