FAKULTA
STAVEBNÍ
ČVUT V PRAZE

CM01 – Concrete and Masonry Structures 1

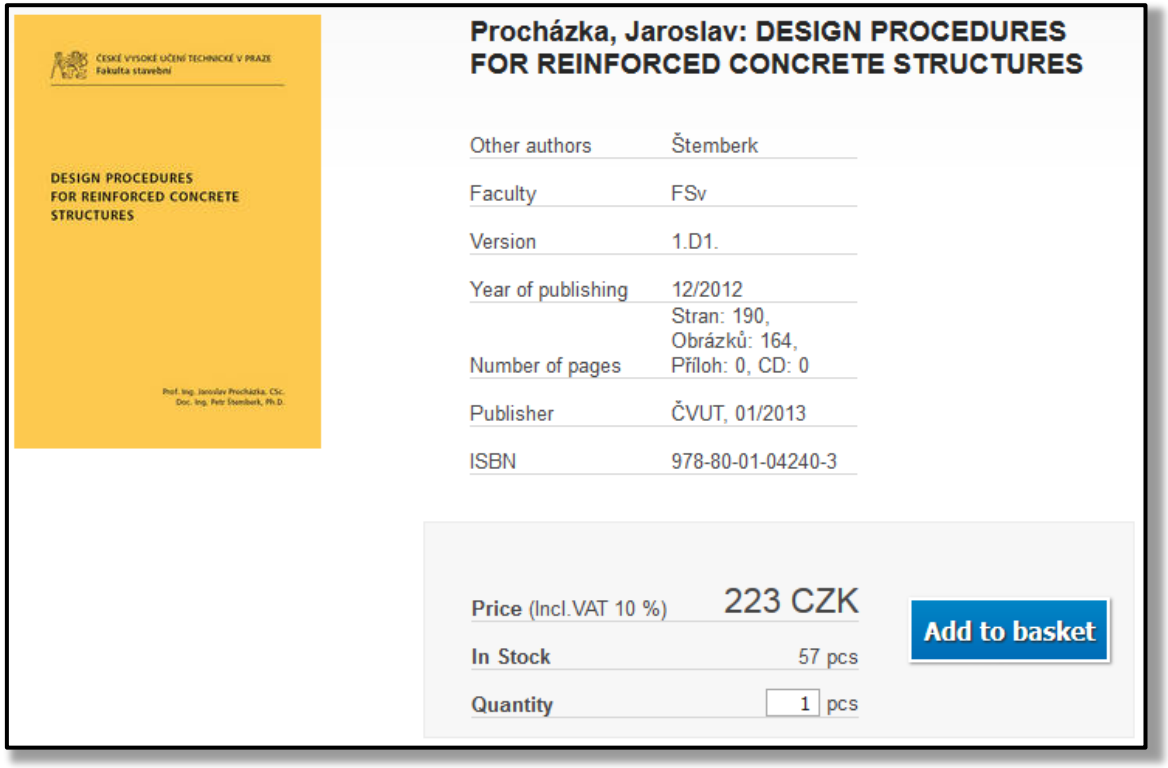
Introductory information to seminars

Author: Jakub Holan

Last update: 26.09.2024 15:27

Course overview

Concrete and Masonry Structures 1 is **an advanced course**. You **must have prior general knowledge of design of concrete structures** – e.g., from the "Fundamentals of Structural Design" course.



https://eshop.cvut.cz/simplifyworks/cs/eoc/public/product/105053161-prochazka-jaroslav-design-procedures-for-reinforced-concrete-structures

Seminar overview

Seminars:

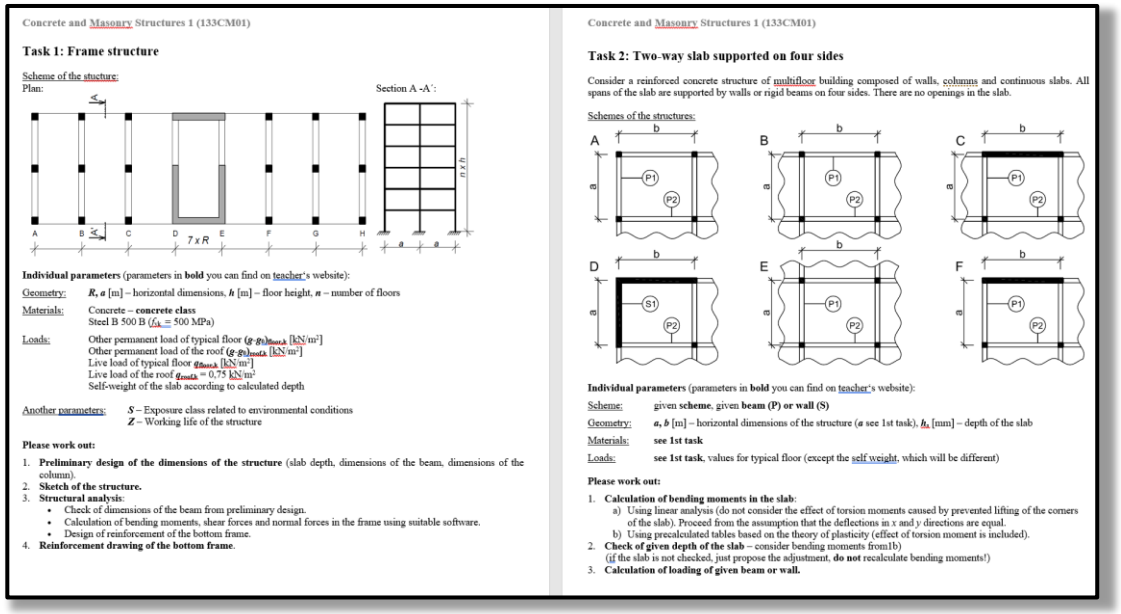
- homework assignment,
- brief explanation of the homework,
- homework consultations and submission.

You must attend the lectures of this course, because **important information needed for the completion of the homeworks will be explained in the lectures**.

Homework assignments

There will be **6 mandatory task assignments** (divided into **12 homeworks**) in this seminar. All of the task assignments are available on my webpage.

Individual **homeworks will be assigned on each seminar**.



Concrete and Masonry Structures 1 (133CM01)

Task 1: Frame structure

Scheme of the stucture:

Plan: Section A -A´:

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

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 $(g\text{-}g_0)_{floor,k}$ [kN/m²]
Other permanent load of the roof $(g\text{-}g_0)_{roof,k}$ [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 according to calculated depth

Another parameters: ***S*** – Exposure class related to environmental conditions
Z – Working life of the structure

Please work out:

1. **Preliminary design of the dimensions of the structure** (slab depth, dimensions of the beam, dimensions of the column).
2. **Sketch of the structure.**
3. **Structural analysis**:
   - Check of dimensions of the beam from preliminary design.
   - Calculation of bending moments, shear forces and normal forces in the frame using suitable software.
   - Design of reinforcement of the bottom frame.
4. **Reinforcement drawing of the bottom frame.**

Concrete and Masonry Structures 1 (133CM01)

Task 2: Two-way slab supported on four sides

Consider a reinforced concrete structure of multifloor 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), 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)

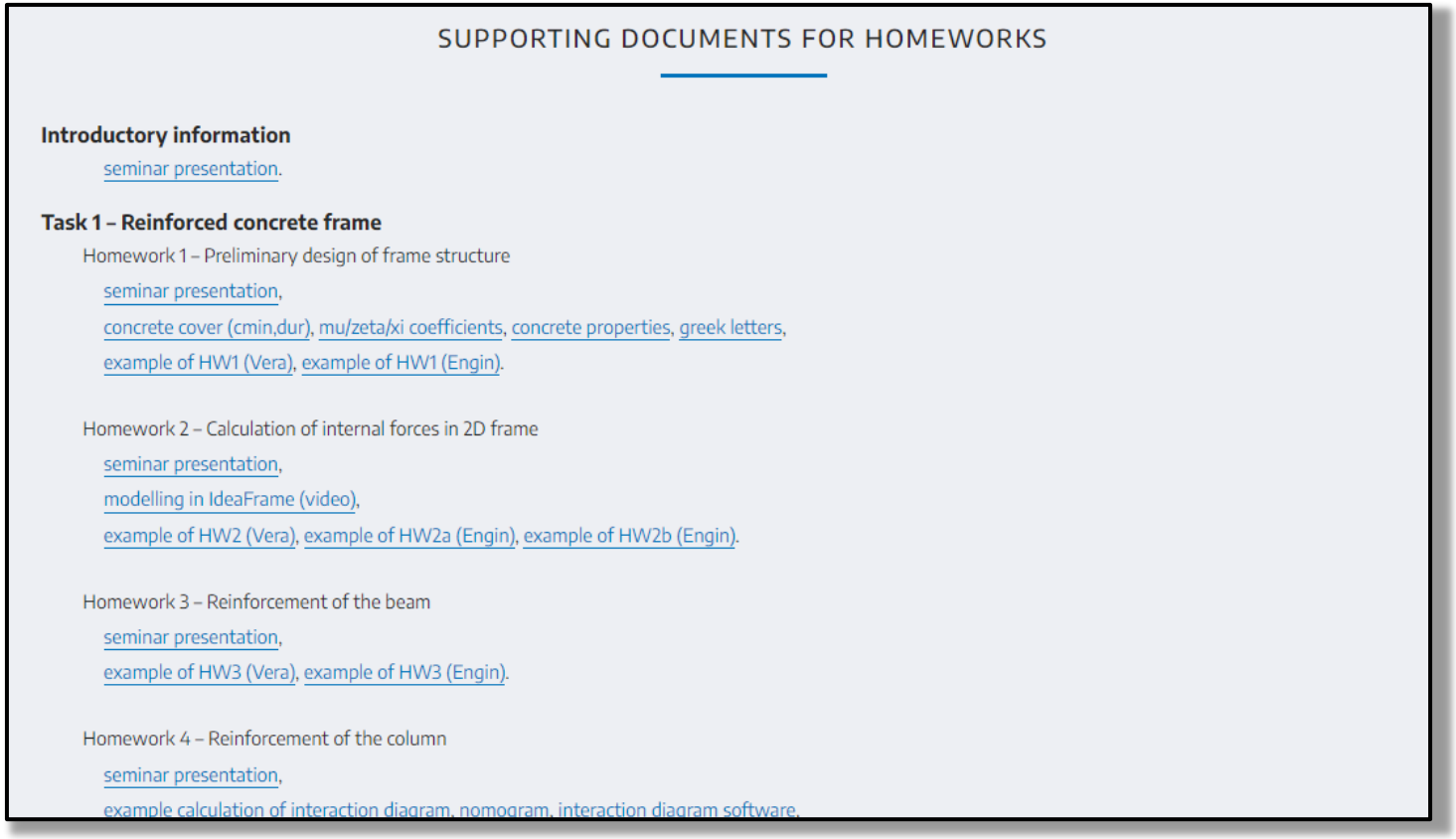
Please work out:

1. **Calculation of bending moments in the slab**:
   a) Using linear analysis (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 precalculated tables based on the theory of plasticity (effect of torsion moment is included).
2. **Check of given depth of the slab** – consider bending moments from1b) (if the slab is not checked, just propose the adjustment, **do not** recalculate bending moments!)
3. **Calculation of loading of given beam or wall.**

		Task 1										Task 2				Task 3	Task 4	
		R	*a*	*h*	*n*	*(g-g0)floor,k*	*(g-g0)roof,k*	*qfloor,k*	*P*	*Z*	*Concrete class*	*Scheme*	*Member*	*b [m]*	*hs [mm]*	*d [m]*	*T*	*W*
No.	Name	[m]	[m]	[m]	-	[kN/m2]	[kN/m2]	[kN/m2]	-	[years]	-	-	-	[m]	[m]	[m]	-	-
1	Castillo Fadda, Francisco	5.4	6.9	3.7	5	1.6	1.8	3.9	XC2	50	C30/37	A	P1	6.7	220	7.1	III	I
2	Cayuela Zilinskaite, Saule	4.1	5.9	3.4	6	1.3	1.6	2.9	XC1	50	C30/37	B	P1	6.9	200	7.1	IV	II
3	Da Silva Do Nascimento Santos, Henriqu	4.3	7.2	3.7	4	0.9	1.7	4.4	XC2	50	C30/37	C	P1	7.3	230	7.1	III	III
4	Duarte Caetano, Joao Pedro	5.0	6.8	4.0	6	1.3	2.1	2.9	XC1	50	C30/37	D	S1	7.3	230	8.3	IV	I
5	Engels, Annalena	5.4	6.2	3.1	5	0.9	1.4	2.4	XC1	80	C30/37	E	P1	7.6	220	8.3	III	II
6	Eusébio Lopes, Alexandre Daniel	4.5	6.4	3.3	4	1.9	1.1	4.9	XC2	80	C30/37	F	P1	6.1	200	8.1	IV	III
7	Fernández Ramos, Ignacio	4.8	4.7	3.6	6	1.8	1.9	4.1	XC1	50	C25/30	A	P2	5.8	170	6.5	III	I
8	Guerra Intriago, William Mathias	4.4	5.6	3.9	7	1.1	1.9	2.9	XC1	50	C25/30	B	P2	5.5	180	6.5	IV	I
9	Lopes Craveiro Maranha Tiago, Paulo M	4.9	6.0	3.3	5	1.4	1.7	4.9	XC2	50	C25/30	C	P2	6.1	190	6.1	III	III
10	Mansilla Sánchez, Gabriel	5.2	5.9	3.4	4	1.1	2.1	4.0	XC2	50	C25/30	D	P2	6.1	190	7.7	IV	I
11	Ponomarenko, Darina	4.0	5.4	3.5	5	1.4	1.4	4.9	XC1	80	C25/30	E	P2	6.7	190	7.7	III	II
12	Rodrigues Lucas, Marco	4.8	4.9	3.7	6	1.6	2.7	4.9	XC1	80	C25/30	F	P2	6.1	180	7.1	IV	III
13	Ruiz García, Juan José	5.3	5.6	3.7	6	1.7	1.8	4.9	XC1	50	C20/25	A	P1	6.7	200	6.7	III	I
14	Slavchev, Borislav	4.9	5.9	3.1	8	1.5	1.7	1.9	XC2	50	C20/25	B	P1	6.1	190	6.2	IV	II
15	Vargas Prussing, Max Moritz	5.1	6.0	3.6	5	1.1	1.7	2.9	XC1	50	C20/25	C	P1	6.1	190	8.3	III	III
16	Yoo, Chaeri	4.2	6.2	3.7	4	2.0	2.1	4.9	XC2	50	C20/25	D	S1	7.0	210	8.6	IV	I
17		5.1	6.2	3.3	5	2.1	1.4	3.9	XC1	80	C20/25	E	P1	7.3	220	7.4	III	II
18		4.6	6.5	3.4	7	1.9	1.1	2.4	XC1	80	C20/25	F	P1	6.7	210	7.4	IV	III
19		5.2	7.1	3.4	6	1.7	1.8	2.9	XC1	50	C30/37	A	P2	6.1	210	7.1	III	I
20		5.5	6.9	3.9	5	1.6	1.9	2.9	XC1	50	C30/37	B	P2	7.6	230	8.1	IV	II
21		5.3	5.9	4.0	4	1.4	1.7	3.8	XC2	50	C30/37	C	P2	6.7	200	7.7	III	III
22		4.7	5.4	4.3	8	1.9	2.4	3.9	XC2	50	C30/37	D	P2	6.1	180	7.1	IV	I
23		5.0	5.6	3.7	6	1.3	1.9	2.9	XC1	80	C30/37	E	P2	5.8	180	7.7	IV	I
24		5.1	6.0	3.2	5	1.6	1.8	4.2	XC1	50	C30/37	F	P2	6.2	200	7.5	IV	III
25		4.9	5.4	3.7	6	1.2	1.8	3.0	XC2	80	C30/37	A	P1	6.2	190	7.7	III	I

Homework support materials

For the assigned homework, support materials (presentations, tables, examples of solved HWs etc.) are available on my webpage.



SUPPORTING DOCUMENTS FOR HOMEWORKS

Introductory information

seminar presentation.

Task 1 – Reinforced concrete frame

Homework 1 – Preliminary design of frame structure

seminar presentation,
concrete cover (cmin,dur), mu/zeta/xi coefficients, concrete properties, greek letters,
example of HW1 (Vera), example of HW1 (Engin).

Homework 2 – Calculation of internal forces in 2D frame

seminar presentation,
modelling in IdeaFrame (video),
example of HW2 (Vera), example of HW2a (Engin), example of HW2b (Engin).

Homework 3 – Reinforcement of the beam

seminar presentation,
example of HW3 (Vera), example of HW3 (Engin).

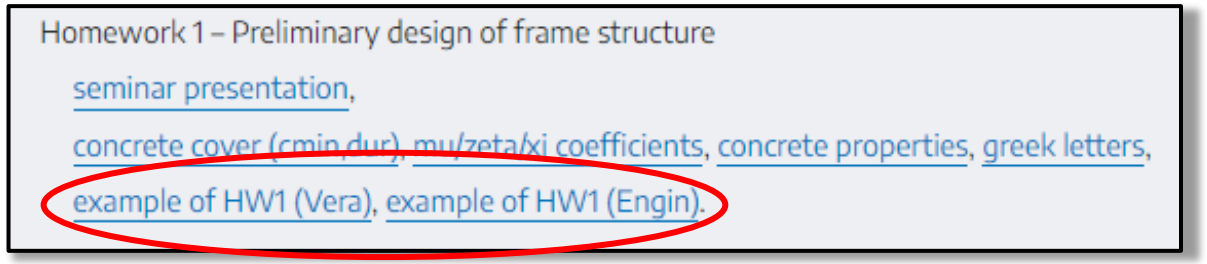
Homework 4 – Reinforcement of the column

seminar presentation,
example calculation of interaction diagram, nomogram, interaction diagram software.

Homework support materials

In order to best understand the topics, **complete the homework on your own using the information from lectures and seminars**.

If necessary, **you can inspire yourself in the "example homework"** on my website. However, keep in mind that there might be mistakes or missing parts in the homeworks, so **do not use them as your primary resource**!



Seminar requirements

In order to **successfully pass the seminar**, you must complete and submit **all homeworks**, in their respective deadlines – see the Seminar programme. Each homework must be **personally consulted** with me, and you must obtain a confirmation of the **successful completion** of the homework from me – see the Completion table.

Recommended submission date for each homework is 1 week after its assignment. **Deadline for each homework is 2 weeks after the assignment***.

If you fail to meet the deadline 2 times, you will fail the seminar, and you will not be able to take the exam and complete the course!

* Under special circumstances (e.g., illness), the deadline can be extended – but only if you request the extension BEFORE the deadline!

Seminar points

During the semester, **you can obtain "seminar points"** which will be used when determining **your final mark in this course**. **The seminar points make 30 % of the final mark!**

You can obtain the points for:

- 1 point for **timely completion** (1 week) of each homework (up to **12 points total**),
- 1 point for **exceptional quality*** of each homework (up to **12 points total**),
- up to **6 points** for **activity†** during the semester.

* Clear and understandable calculations with adequate titles, notes, and pictures.
† Communication during the seminars and good understanding of the topics.

Homework rules

There are **specific rules** regarding the form of the homeworks.

- Write your homework on **one-sided A4 paper with 5 cm left margin**.
- All **load calculations must be done in tables**.
- Draw **simple but clear schemes** (for better understanding).

5 cm

$M_{Ed} = 1/8*f*L^2$

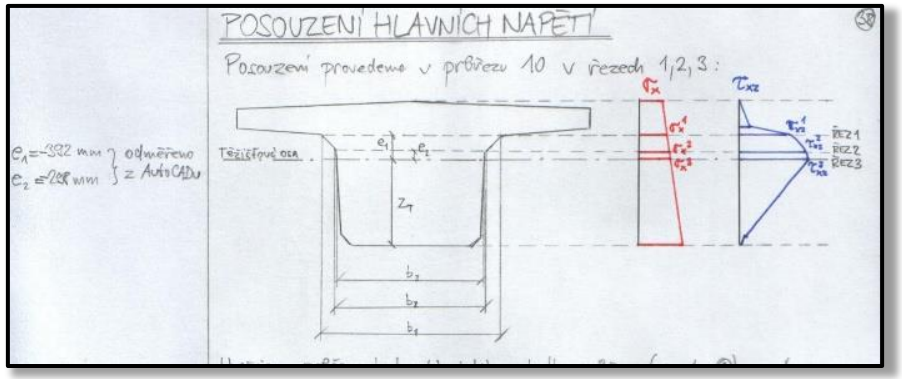
$M_{Ed} = 1/8*8*5^2$

$M_{Ed} = 25$ kNm

Load	Char.	γ_F	Design
...	...	1,35	...
...	...	1,50	...
			TOTAL

SLAB LOAD

Type	Name	f_k [kN/m²]	γ_F	f_d [kN/m²]
Permanent (Dead load)	-Surface layer (carpet/ceramic)	0.20	1.35	0.27
	-Glue layer	0.01	1.35	0.01
	-Concrete (leveling layer)	1.25	1.35	1.69
	-Separation foil	0.01	1.35	0.01
	-Acoustic insulation (EPS/XPS)	0.05	1.35	0.07
	-Reinforced concrete	0.28*25=6.88	1.35	9.28
	-Plaster	0.06	1.35	0.08
	-Partitions	0.11	1.35	0.15
Variable (Live load)		2.00	1.50	3.00
Total		∑ = 10.57		∑ = 14.56



Homework rules 2

There are **specific rules** regarding the form of the homeworks.

- Homework must be **well arranged, clear, and controllable**.
- Pages must be **numbered** (for cross referencing).
- All **calculations and assumptions** used in the analysis **must be written**.
- Write **general equations** (with letters), **specific equations** (with numbers), and **results with units**.

Submitted homework which will not in accordance with these rules will be returned to you for revision.

Introductory test

Assignment 1

Calculate the **design area load** $\boldsymbol{f_{a,d}}[\mathbf{kN/m^2}]$ on a concrete slab (plate). The slab is $200\ \mathrm{mm}$ thick and is loaded by:

- slab self-weight,
- other dead (permanent) load: $f_{(g-g_0),k} = 1.5\ \mathrm{kN/m^2}$,
- live (imposed) load: $f_{q,k} = 3\ \mathrm{kN/m^2}$.

Hint:

$g_0 = h\,\gamma_c$

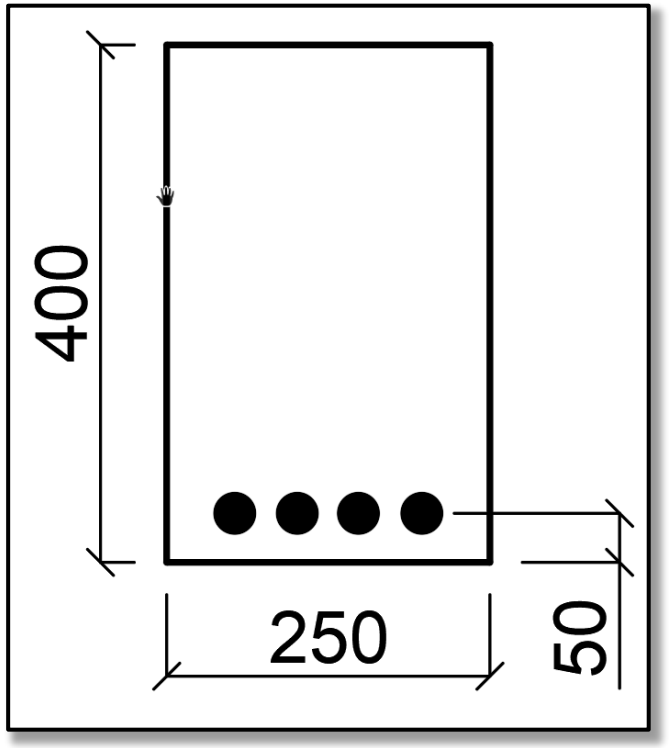
$\gamma_G = 1.35$

$\gamma_Q = 1.5$

Assignment 2

Calculate the **load-bearing capacity of a cross-section in bending M_{Rd}** of the given cross-section. Overall area of steel rebars is $A_s = 800\ \mathrm{mm}^2$. Materials:

- concrete C30/37,
- steel B 500B.



Hint:

Calculation steps:

1) $f_{cd} =$ … and $f_{yd} =$ …
2) $x =$
3) $z =$
4) $M_{Rd} =$

thank you for your attention