CM01 – Concrete and Masonry Structures 1

Introductory information to seminars

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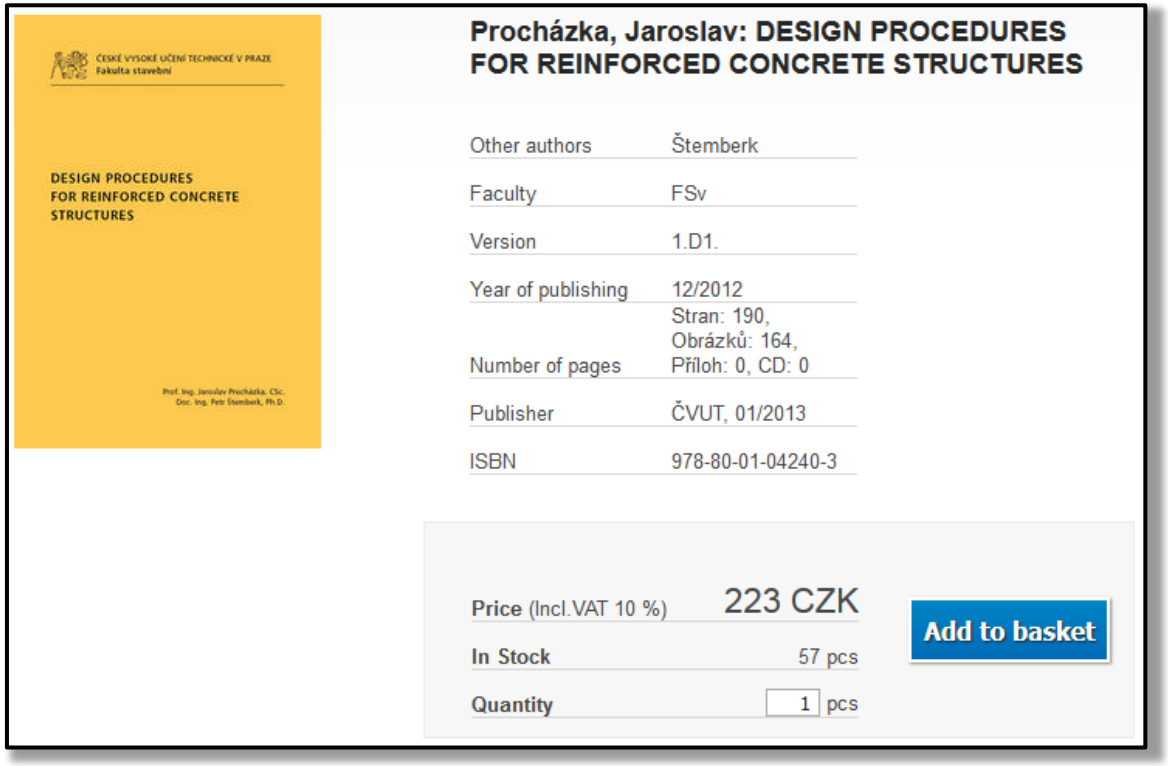
Course overview

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://eobchod.cvut.cz/ctu_study_notes/ctu_study_notes/design_procedures_for_reinforced_concrete_structures-150028012

Seminar overview

Seminars:

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

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

Seminar requirements

In order to **successfully pass the seminar**, you must:

- complete and submit **all 12 homeworks**,
- earn at least **24 homeworks (HW) points**.

You **earn HW points** based on how quickly you submit your homework after the assignment. **For precise dates** see Seminar programme. Approximate dates are:

- 1 week after the assignment: 3 points,
- 2 weeks after the assignment: 2 points,
- 3 weeks after the assignment: 1 points.

Seminar requirements

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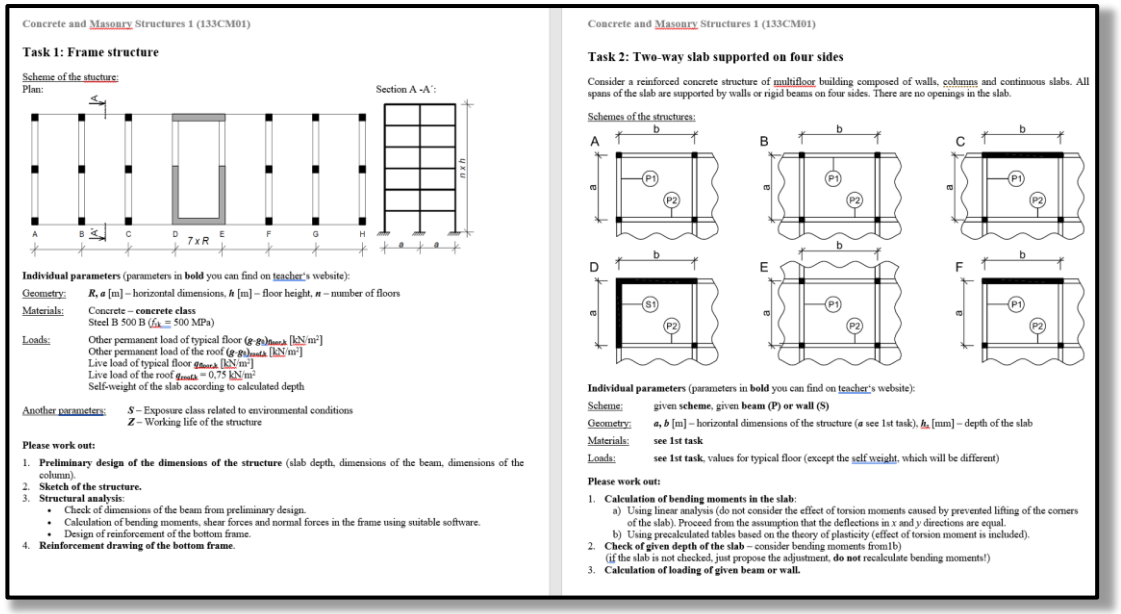
Seminar number	Seminar date	Task	Homework	Submission date 1 (for 3 HW points)	Submission date 2 (for 2 HW points)	Submission date 3 (for 1 HW points)	Final submission date (latest date for submission)
Seminar 1	Fri 23.09.2022	**Task 1** Reinforced concrete frame	Preliminary design of frame structure	30.09.2022	07.10.2022	14.10.2022	21.10.2022
Seminar 2	Fri 30.09.2022		Calculation of internal forces in frame structure	07.10.2022	14.10.2022	21.10.2022	28.10.2022
Seminar 3	Fri 07.10.2022		Reinforcement of the beam	14.10.2022	21.10.2022	28.10.2022	04.11.2022
Seminar 4	Fri 14.10.2022		Reinforcement of the column	21.10.2022	28.10.2022	04.11.2022	11.11.2022
Seminar 5	Fri 21.10.2022		Reinforcement drawing	04.11.2022	11.11.2022	18.11.2022	25.11.2022
	Fri 28.10.2022		*Seminar canceled - state holiday (no classes on this day)*				
Seminar 6	Fri 04.11.2022	**Task 2** Two-way slab	Two-way slab supported on 4 edges	11.11.2022	25.11.2022	02.12.2022	09.12.2022
Seminar 7	Fri 11.11.2022	**Task 3** Slab supported by columns	Two-way slab supported on columns - dimensions, moments	25.11.2022	02.12.2022	09.12.2022	16.12.2022
Seminar 8	Mon 14.11.2022		Two-way slab supported on columns - bending and punching reinforcement	25.11.2022	02.12.2022	09.12.2022	16.12.2022
Seminar 9	Tue 15.11.2022	**Task 4** Stiffening wall	Design and assessment of stiffening walls	25.11.2022	02.12.2022	09.12.2022	16.12.2022
	Fri 18.11.2022		*Seminar canceled - Dean's day (no classes on this day)*				
Seminar 10	Fri 25.11.2022	**Task 5** Staircase	Reinforced concrete staircase - design	02.12.2022	09.12.2022	16.12.2022	06.01.2023
Seminar 11	Fri 02.12.2022		Reinforced concrete staircase - assessment	09.12.2022	16.12.2022	06.01.2023	06.01.2023
Seminar 12	Fri 09.12.2022	**Task 6** Structural drawing	Structural drawing	16.12.2022	06.01.2023	-	06.01.2023
		Task 7 Pad footings	Pad footings				
Seminar 13	Fri 16.12.2022		Homework consultations and submissions.				
	Fri 06.01.2023		Additional homework consultations and submissions.				
			Latest date for successful submission of homework and passing the seminars.				**06.01.2023**

Homework assignments

All of the task assignments and support materials are available on Dr. Bílý's page.

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.**

No.	Name	Task 1										Task 2				Task 3	Task 4	
		R	a	h	n	(g-g0)floor,k	(g-g0)roof,k	qfloor,k	P	Z	oncrete clas	Scheme	Member	b [m]	hs [mm]	d [m]	T	W
		[m]	[m]	[m]	-	[kN/m2]	[kN/m2]	[kN/m2]	-	[years]	-	-	-	[m]	[m]	[m]	-	-
1	Avramita, Mara	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	Björk, Sofie	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	Bonnin, Andréa	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	Charles Moody, Henry	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	Lambaek, Jeppe	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	Larssen, Line Karina	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	Mackenzie, Stephen	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	Nogueira Carvalho, Jorge Gregory	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	Pacheco Pereira Cavaco, Pedro	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	Pedrosa De Sousa, Miguel Alexandre	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	Pereira Amado, Ricardo Luís	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	Teodorescu, Andrei-Cosmin	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		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		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		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		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 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

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

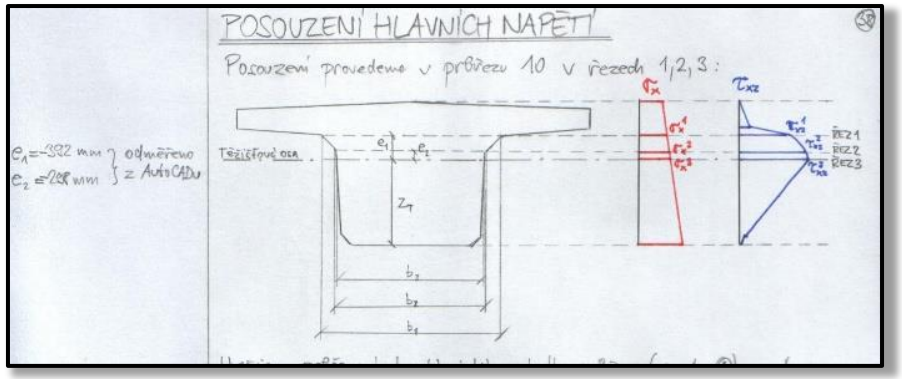
$M_{Ed} = 1/8*8*5^2$

$M_{Ed} = 25$ kNm

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

SLAB LOAD

Type	Name	f_{ck} [kN/m²]	γ_F	f_{cd} [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**.

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:

- 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:

$g_0 = h\,\gamma_c$

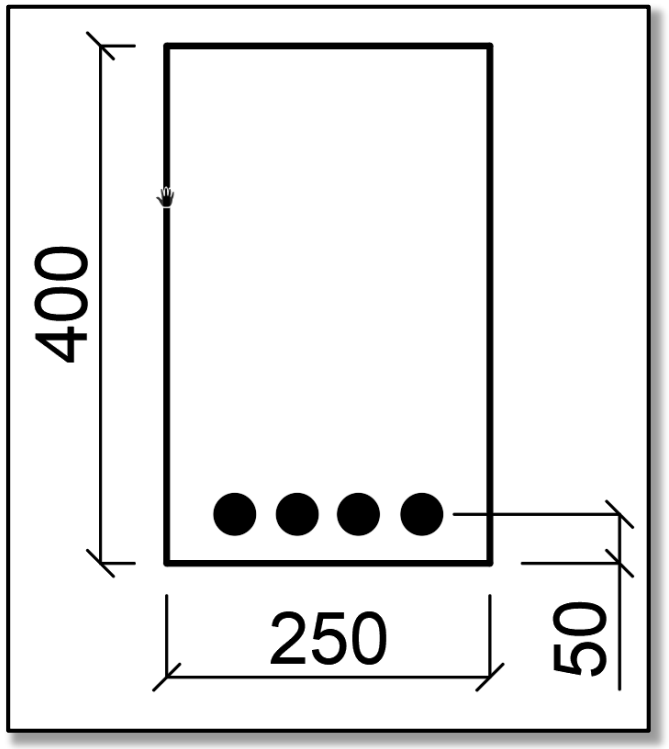
$\gamma_G = 1.35$

$\gamma_Q = 1.5$

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