

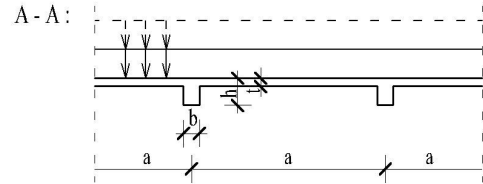
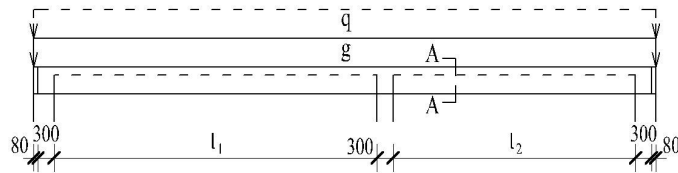
## DESIGN EXERCISE 1.

### Design of continuous beam with three supports

Deadline: 12. April 2012.

Name:	Code:
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Data



code	Materials A	Load zone width m a	Shear reinforcement V	Beam width mm b	Clear span m L
1	C20/25-16/ F2 B 500	3,90	Bent-up bars + link	270	$l_1=5,15$ $l_2=4,70$
2	C25/30-16/ F2 B 500	4,45		330	$l_1=5,60$ $l_2=5,25$
3	C30/37-16/F2 B 500	5,10		410	$l_1=6,05$ $l_2=5,40$
4		5,65			$l_1=5,30$ $l_2=4,95$

Explanation of code: AaVbL for example: 32123 means:

A: C25/30-24/KK a=4,2 m V: bent-up bars + link b=300 mm  $l_1=6,00$  m  $l_2=5,10$  m

Thickness of slab under different load zones:

Loading strip (load zone) width (a)	3,90 m	4,45 m	5,10 m	5,65 m
Thickness of slab (t)	150 mm	160 mm	180 mm	200 mm

#### Common data:

-Floor coping layers + plaster self weight characteristic value:  $2,5 \text{ kN/m}^2$  (without the volume weight of reinforced concrete slab!)

-Characteristic value of average partition wall load:  $g_{kw}=1,5 \text{ kN/m}^2$

-Characteristic value of live load:  $q_k=2,0 \text{ kN/m}^2$

-Concrete cover:  $c_{nom}=20 \text{ mm}$

-Height of beam:  $h$  must be calculated (must be whole multiple of 20 or 50 mm!)

-Link material:  $\phi 6$ : B 240,  $\phi > 6$  mm: B 400 or B 500 (depending on bars)

The self weight of RC structure can be calculated from the geometry (given thickness of slab and estimated height of beam). The design value of actual bending moment must be calculated from load combinations! If there must be changes in the height of the beam (wrong estimation at start), the weight calculations doesn't have to be updated (weight changes are usually under 5%). At  $-M_{max}$  calculate as doubly reinforced cross-section, where the compression steel should carry 20-40% of the moment, so the cross-section of the beam can be better exploited at the segments with positive bending moment!

#### Tasks:

- Calculate and draw the reinforcement project of continuous beam with three supports. For the data, use the code given above! Scales: S=1:50 (section) and S=1:20 (cross-sections).
- Make the list of bars!
- Check the stiffness and crack size using simplified methods!

Maximum deflection:  $w_{max} \leq l_{eff}/250$       Crack width:  $w_{k,max} \leq 0,3 \text{ mm}$

The drawings can be made by pencil – using different line widths (0,3-1,0 mm) – on tracing paper, mounted on A3 size carrier paper. The cross-sections should be shaded green on the back side of the tracing paper! The calculations and sketches must be attached on A4 sheets in a folded A3 jacket with indication of title and name. Place the drawings folded to A4 size in the same jacket!

There is a sample drawing on the back side of this paper you can use. Questions about solving the exercise will be answered during consultation hours on the department.

You can find some useful advices on the back side of DE2!

## DESIGN EXERCISE 2.

### Design of reinforced concrete slab and column

**Deadline: 10. May 2012.**

Name:	Code:			
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Data:

code	Floor plan configuration <b>K</b>	materials <b>A</b>	Live load $q$ (kN/m <sup>2</sup> )	
			apartment	balcony, stairs
1	A	C20/25-16/F2 B 500	2,0	3,0
2	B	C25/30-16/ F2 B 500	3,0	4,0
3	C	C30/37-16/ F2 B 500	4,0	4,0
4			5,0	5,0

**Explanation of code:** KA $q$  for example: 321 means:

K: C-type A: C20/25-24/K and B 500  $q$ : apartment: 2,0 kN/m<sup>2</sup>, balcony, stairs: 3,0kN/m<sup>2</sup>

**Common data:**

-Floor coping layers:

Ceramic tiles	8 mm
Bedding mortar	25 mm
Floating lean concrete	60 mm
Polyethylene foil	
ETHAFOAM	5 mm
RC slab	as estimated
Plaster	15 mm

-layers of stairs and balcony:

artificial stone	40 mm
RC slab:	as estimated
plaster	15 mm

-Characteristic value of average partition wall load: 1,5 kN/m<sup>2</sup>

-Concrete cover both in slab and column:  $c_{nom} = 20$  mm

-Number of floors: ground floor + 2 storeys, storey-height: 3,0 m

The self-weight of the reinforced concrete structure can be calculated from the geometry using the given and assumed data.

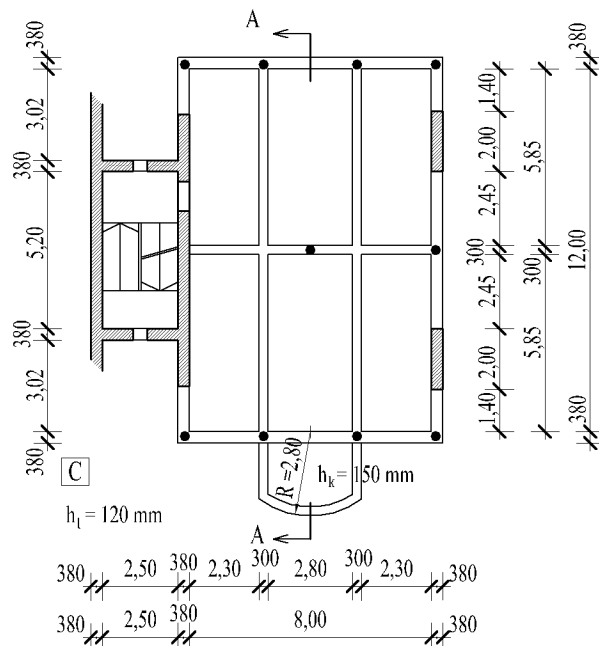
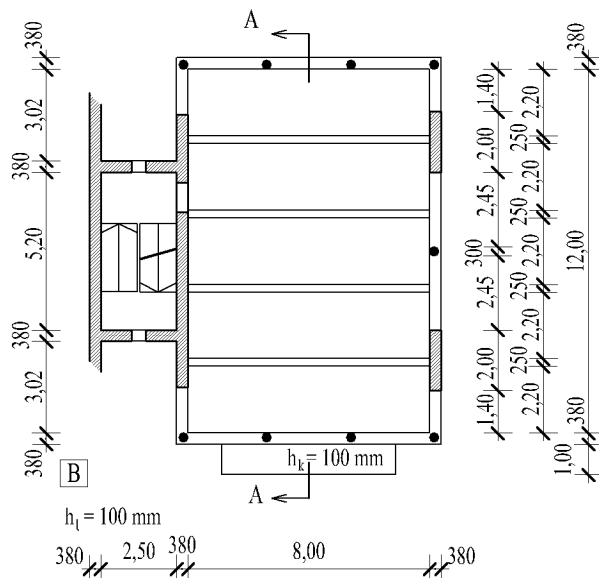
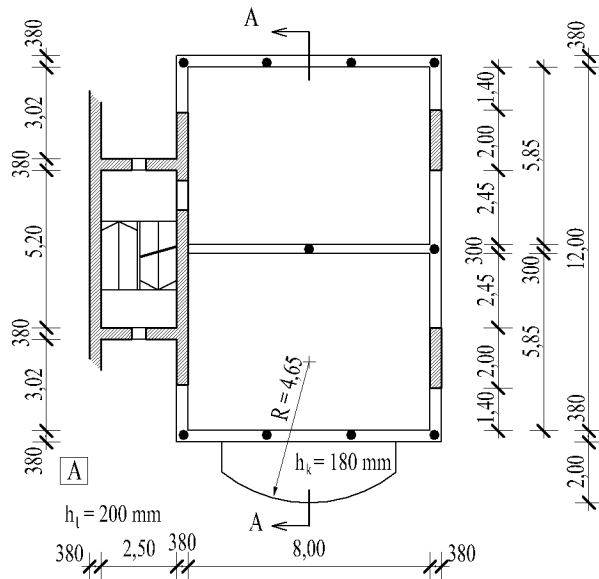
**Tasks:**

Calculate and draw the reinforcement projects of

- the *reinforced concrete slab* given by the code – floor plan plotted on the back side - and
- the most heavily loaded ground floor *reinforced concrete column*.

Beams should not be designed, only an assumed cross-section is needed for the section drawings. Make the simplified check of the deflection of the slab. If necessary, indicate the need of eventual hogging of the slab. Calculation of the crack width is not necessary. Draw an S=1:50 scale floor plan and section of the slab and an S=1:20 scale cross-section of the column! All elements of the slab reinforcement must be shown on the floor plan. All different elements of the reinforcement should be drawn beside the floor plan or section in projectional correspondence giving all necessary data: specification number, number of bars, diameter (mm), spacing (mm), full length (m), part lengths (mm). List of bars is not necessary, but all elements must be identifiable using the specification number! The drawings can be made by pencil – using different line widths (0,3-1,0 mm) – on tracing paper, mounted on carrier paper. The calculations and sketches must be attached on A4 sheets in a folded A3 jacket with indication of title and name. You can find some typical reinforcement projects in the 10th chapter of the Reinforced concrete design aids.

FLOOR PLAN SCHEMES FOR DE2



Propositions for preparing the DE

Remarks concerning presentation form: For writing down the calculations use a pencil, write only on one side of the paper! Use a wide margin, leave space for notes and corrections. Make a catalogue of contents!

Recommended content of the design exercise I:

1. Data, applied codes, materials.
2. Loads
3. Calculation of internal forces
  - 3.1. Static model
  - 3.2. Calculation of moments from loading schemes, diagram of extreme moments
  - 3.3. Calculation of shear forces, diagram of extreme shear forces
4. Design of cross-sections
  - 4.1. Design for moment (left span, right span, support)
  - 4.2. Design for shear at the sections of  $V_{Ed,max}$  values
5. Detailing of bars, construction of envelope moment diagram of resistance moments
6. Check the beam end
7. Simplified check of stiffness (deflections)
8. Check of crack width
9. Detailed drawing of the beam S=1:50, 1:20

Longitudinal section  
(All steel bars indicated)

Cross-sections

List of bars

$h_1$ : thickness of RC slab

$h_k$ : thickness of balcony RC slab

**SAMPLE DRAWING FOR DESIGN EXERCISE 1.**  
Reinforcement project of continuous beam with three supports

