

## Exam 12.12.2011

*Exam duration: 3 hours*

*General remarks:*

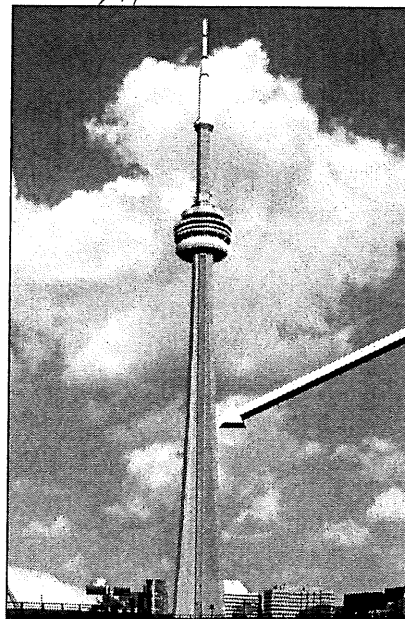
- *Exam should be written in English*
- *It is allowed to use a dictionary*
- *You must return the examination questions with your work!*

*Requirements:*

- *You must have passed the Concrete Technology I course*
- *You must have finished your design exercise or at least received confirmation from Jukka Makinen allowing to attend the exam*

## Production Technology of Concrete Structures Rak-82.2121

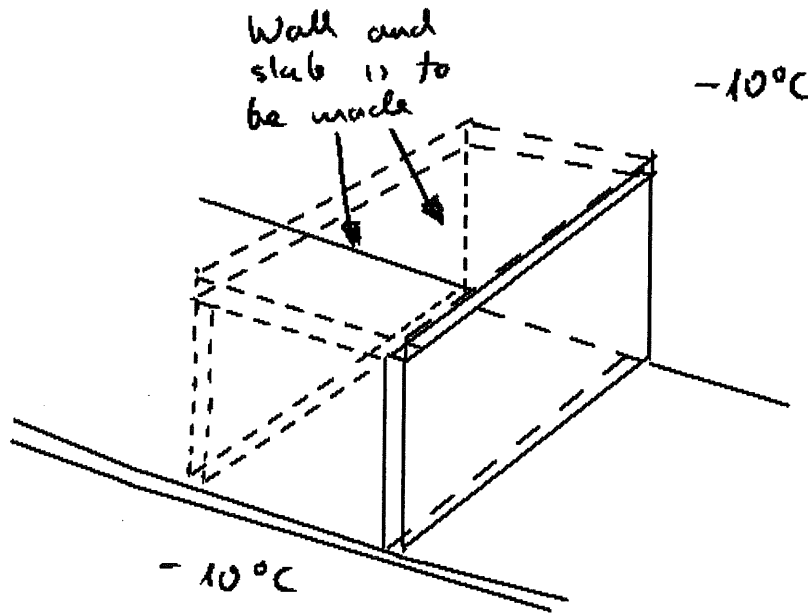
1. Choose type of formwork for structure shown below.
  - a. Justify your choice and point out at least 2 alternatives and indicate their drawbacks/benefits in comparison with your choice **2p**
  - b. Make schematic drawings of chosen system and name its main parts (clearly mark lifting mechanism and working platforms!) **1.5p**
  - c. Describe the concrete casting process (including montage of formwork, reinforcement, casting (e.g. speed), curing) **2.5p**



Only this part!

2. Winter concrete works.

- a. Define the freezing strength and consequences of mixing water freezing  
**1p**
- b. Choose the heating method for the structure shown below (in connection with formwork type); indicate the locations of heaters (if needed), indicate the main problems. Outside temperature  $-10^{\circ}\text{C}$  (also below the existing slab) **3p**

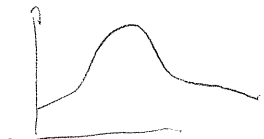


3. Describe alternative types of reinforcement (do not describe reinforcing steel bars!). Describe principle of their usage, benefits and drawback in comparison with normal steel bar reinforcement, **2p**

4. Hot weather concrete works and massive structures

- a. Define conditions when "hot weather" principles for concrete works should be applied **1p**
- b. Define the plastic shrinkage and describe how to prevent cracking of concrete due plastic shrinkage? **2p**
- c. What is the maximum concrete temperature and maximum temperature gradients within the element (during hydration processes). How do the type of coarse aggregate affects the maximum temperature gradient within the concrete element during curing **2p**
- d. Describe and draw the affect of the subgrade (a surface on which the concrete element is made) on thermal cracking of massive structure, draw typical crack pattern, **1p**
- e. Describe basic recommendations for mix design of concrete to be used in massive structures or at ambient temperatures of 30 degrees (e.g. type/amount of cement, secondary binders, and admixture). **2p**
- f. Describe methods for lowering fresh concrete temperature, **2p**

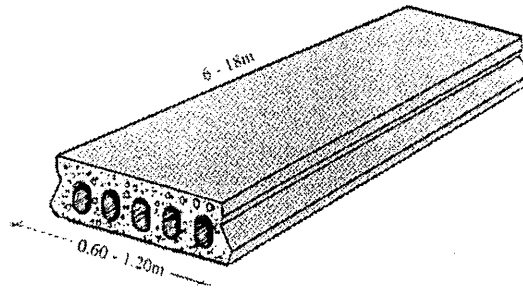
10-30



5. Precast concrete

The task is to produce 6 pre-stressed hollow core slabs as shown below (all slabs have width of 1.2 m and length of 6 m !).

- Describe principle of slip forming of hollow core slabs (sketch the cross section of the slip forming machine and mark concrete movement within the machine), **2.5p**
- Draw production line (indicate and name all needed machines) **1.5p**
- Describe required properties (workability and early strength) of concrete mix used for extrusion **1p**



6. Describe the optimal curing procedure:

- Draw figure showing heat development of a typical concrete (time vs heat) **1p**
- Mark types of shrinkage occurring at each characteristic part of that curve **1.5p**
- Describe recommended actions preventing shrinkage for each characteristic part of that curve **1.5p**
- List type of available curing methods **1p**

- WATER + CO<sub>2</sub>  
- LWA AIR