

- Open book exam / Online exam
- Write on the answer document: your surname, first name and student number.
- **You may use Paint or any other image editor to draw concepts, then copy/past the image to your answer documents.**
- **You may use Excel or any other software for calculations, then copy/past as an image to your answer documents.**
- Please justify your calculation with steps and equations used.

Sukunimi (myös aik.) / Family name (incl. previous) enter last name	Etunimet / First name(s) enter 1st name.	Opiskelija nro / Student nbr				
Tutkinto-ohjelma / Degree Programme Building Technology	Kursseekoodi ja -nimi / Course code and name CIV-E2030 - Experimental Methods in Building Materials L					
	Syntymäaika / Date of Birth	Tentin pvm / Date of exam 25.5.2020				
Opettaja(t) / Teacher (s)	Tarkastaja täyttää / Filled by the examiner					
Fahim Al-Neshawy Jouni Punkki	1	2	3	4	5	6

Question 1.

(15p)

A condition of a reinforced concrete column and on-grade slab was performed using ultrasound pulse velocity (UPV) technique. The cross section of the column is 400 mm x 400 mm and the thickness of the on-grade slab is 300 mm. The UPV measurement results are presented below.

	RC column			RC on-grade slab		
	A	B	C	A	B	C
Distance between transducers in (mm)	400	450	450	100	300	450
UPV transit time (µs)	125	300	110	55	120	90

- Based on the measurement results, what were the possible transducers configuration for the column and slab in locations A, B and C. (*hint: use an image editor or power point to draw a sketch then copy and paste it*)
- Evaluated the quality of the concrete for the column and slab in locations A, B and C.
- Calculate the dynamic elastic modulus of the concrete for the column and slab in locations A, B and C (assume the density of concrete is 2500 Kg/m³). *Justify your answer with the equation of calculation.*
- What are the variables that affect ultrasonic pulse velocity testing (UPV) results?

ANSWER OF QUESTION 1.

Question 2.

(15p)

Your task is to perform the quality control (QC) of a prestressed concrete bridge girder. Select a suitable electromagnetic NDT testing method for evaluating the location and condition of the prestressing strands, ducts and grouting materials.

- What is the principle of the selected NDT techniques?
- Describe shortly how the selected NDT measurement data are analyzed.
- What are the advantages and limitations of the selected NDT techniques?

ANSWER OF QUESTION 2.

Question 3.

(15p)

- Explain in which situation in-situ compressive strength of concrete structures is needed to measure. What kind of test methods could be used?
- Explain the differences between site specimens and in-situ testing of compressive strength of concrete. Which factors may cause differences in the test results?
- In a project, the following compressive strength results (MPa) were achieved. Analyze the results, is the concrete fulfilling the strength requirements? The nominal strength class is C35/45.
 - Site specimens: 150 mm cubes
 - In-situ specimens: Drilled specimens from the structure: diameter = 80 mm, length = 80 mm.

Site specimens		In-situ specimens
45,0		40,2
48,2		42,5
46,8		43,3
48,0		44,3
46,7		37,0
41,0		42,8

ANSWER OF QUESTION 3.

Question 4.

(15p)

- What are the benefits of thin-section examination of new and existing concrete structure?
- Describe how the thin-section analysis can provide information about the deterioration of concrete structures. Support your answer with examples.
- Describe how the thin-section analysis can provide information about the quality of concrete (cement, water, aggregates, additives). Support your answer with examples.

ANSWER OF QUESTION 4.

Question 5.

(15p)

Your task is to investigate the corrosion rate of reinforcement steel at cool water intake tunnels in nuclear power plant.

- Select a suitable method for the investigation and describe the principle of the method.
- Describe how the measurement data are processed and how the corrosion rate is evaluated.

- c) What are the advantages and limitations of the selected method?

ANSWER OF QUESTION 5.