

EXAMINATION

10.10.2020

(15p)

(1/5)

Sukunimi (myös aik.) / Family name (incl. previous)	Etunimet / First name(s)			Opiskelja nro / Student nbr		
enter last name	enter 1st name.			000000		
Tutkinto-ohjelma / Degree Programme enter degree programme.	Kurssikoodi ja -nimi / Course code and name CIV-E2060 - Production Technology of Concrete Structures L					
	Syntymäaika / Date of Brirth			Tentin pvm / Date of exam		
	01.01.1990			22.10.2020		
Opettaja(t) / Teacher (s)	Tarkastaja täyttää / Filled by the examiner					
enter 1st teacher's name.	1	2	3	4	5	6
enter 2nd teacher's name.						

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

Question 1. Common masonry materials

- 1.1 The CE marking system for clay bricks proves conformity for products in the European market. Durability against freeze and thaw is an item in the CE marking.
 - Explain the freeze/thaw damage mechanism in clay bricks
 - Describe the different freeze/thaw categories for clay bricks
 - What are the suitable applications for each category?
- 1.2 Compare between clay bricks and calcium-silicate bricks in terms of their:
 - raw materials
 - mixing process of materials
 - forming (molding) of brick units
 - hardening of brick units



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Question 2. Miscellaneous questions

- 2.1 Describe <u>shortly</u> the pre-stressing method for (a) small sections of hollow core slabs (≈ 17 m span) manufactured in factory and (b) long-span concrete girder bridge (≈ 250 m span) constructed on site.
- 2.2 Write **<u>short</u>** note about the bitumen emulsion and its use.
- 2.3 Explain **<u>shortly</u>** the cement hydration process and its stages.
- 2.4 Write **<u>short</u>** note on the moisture effects on the performance of building materials.



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Question 3. Wood

- 3.1 A direct tensile test was carried out to determine the modulus of elasticity for a 4×4 wood lumber (100×100×2500 mm) as show in the Fig. to the right. The test results during the elastic deformation of the wood were:
 - Tensile load F = 240 kN
 - Longitudinal deformation $\Delta L = 4 \ mm$
 - a) Calculate the longitudinal modulus of elasticity (E_L) of the wood lumber
 - b) Assume that the radial grain direction modulus of elasticity $E_R = 10\% \times E_L$. Calculate the radial deformation Δb for the same stress.
- 3.2 The moisture content of a piece of wood (200 mm×150 mm×30mm) was determined by the standard practice used in the timber industry.
 - The mass of wood specimen immediately after it was cut from a board (Initial mass) was 473,76 g.



- The wood specimen was wetted until it has reached a (wet) mass of 549,9 g.
 - (a) Determine the density of the piece of wood in the dry condition
 - (b) Determine (i) the initial moisture content of the test piece after cutting and (ii) the moisture content after wetting.
 - (c) Calculate the final dimensions of the wood in all direction after wetting. Assume that the swelling of the wood in the longitudinal direction ($\alpha_L = 0.75\%$), in the radial direction ($\alpha_R = 5\%$) and the tangential direction ($\alpha_T = 9\%$).







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Question 4. Concrete

- 4.1 A cylindrical concrete specimen (diameter = 150 mm and height = 300mm) was cast from a concrete mixture of 1:6:0.5 (Cement : SSD Aggregate : Water batched by weight). Consider the following data:
 - The designed target air content of the mix is 2%.
 - The mass of the cylindrical mold is 9.0 kg
 - The mass of the cylindrical mold and fresh concrete is 21,7 kg
 - The saturated-surface dry (SSD) aggregates contain 40% sand and 60% gravel.
 - The total moisture content of the sand and gravel is 4% and 2% respectively.
 - The water absorption of the sand and gravel is 1% and 0,8% respectively.
 - Assume that the specific gravity of cement = 3,15 and aggregate 2,67.
 - (a) Calculate the density of fresh concrete mix
 - (b) Calculate the amount of cement, sand, gravel and water in the cylindrical specimen.
 - (c) Calculate the <u>real air content</u> of the fresh concrete mix

Answer to question – 4

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- 5.1 A **bituminous mixture** contains 60% coarse aggregate (specific gravity, SG=2.75), 35% fine aggregate (SG=2.55), and 5% bitumen binder by weight of mix (SG=1.02). Bitumen absorption of the aggregates is 1.2%. The bulk specific gravity of the compacted mixture was found to be 2.42. Compute the following:
 - (a) Calculate the specific gravity of the combined aggregates
 - (b) Total effective bitumen content by weight of mix (%)
 - (c) % voids filled with bitumen (VFA)
 - (d) % air voids in the compacted mixtures.
 - (e) % voids in mineral aggregate (VMA)