

- The exam is an open-book exam. The exam questions are composed of essay questions and calculation questions.
- Answers should be handwritten (on papers). Answer sheets can be any type of paper and each page must include the following details:
  - Course code, name (CIV-E 1010 Building Materials), Exam date: 15.12.2020
  - Your name, (student) number and your signature
  - (Page number / total number of pages)
- You shall scan your handwritten answers and upload scanned documents as a pdf-file to the myCourses assignment folder of the questions "[Exam on 15.12.2020 \(16:30 - 19:30\)](#)".
- **Please justify your calculation with steps and equations used.**

**Question 1.****(15p)**

- 1.1 What are the main types of engineered wood products? and what are the main advantages of engineered wood products over natural-timber members?
- 1.2 Classify the clay brick units based on types.
- 1.3 As a material engineer in charge of designing concrete mix and facing the following problems, which admixture would you use in each case during mixing or at the jobsite?
  - a) There is a large quantity of freshly mixed concrete and the work at the jobsite had to stop because of rain.
  - b) More time is expected to be needed for finishing concrete.
  - c) The structure is subject to freezing.
  - d) Concrete is to be around tightly spaced reinforcing steel.
  - e) High early strength concrete is required, but not necessarily high ultimate strength.

**Question 2.****(15p)**

- 2.1 Compare the Los Angeles and Nordic Ball Mill abrasion test for evaluating the abrasion resistance of aggregates.
- 2.2 Describe the following types of asphalts (bituminous mixtures) and list their benefits:
  - Hot-mixed asphalt (HMA).
  - Warm-mixed asphalt (WMA)
  - Cold-mixed asphalt (CMA)
- 2.3 What are the common forms and types of concrete (conventional) reinforcing steel rebar?

**Question 3.****(15p)**

- 3.1 A dry mortar silo with volume of  $18 \text{ m}^3$  is filled with a dry masonry mortar of 1:5 cement to sand by volume. Consider the following data:
  - Specific gravity of cement = 3,15
  - Specific gravity of dry sand = 2,20
  - Water is added in mix mortar in about 20% of its dry volume
  - Water absorption coefficient of sand = 0.5%
  - a) How much cement and sand required to fill the silo?
  - b) Calculate the water to cement ratio of the mortar
  - c) How much effective water is used for the total amount of mortar in the silo?



- 3.2 A hollow concrete masonry unit has actual gross dimensions of 390 mm × 190 mm × 190 mm (Length × height × width). The unit is tested in a compression machine with the following results:
- Failure load = 1110 kN
  - Net volume = 0,006 m<sup>3</sup>
- a) Calculate the gross area compressive strength.  
b) Calculate the net area compressive strength.

**Question 4.****(15p)**

- 4.1 Your task is to design an expansion joint for masonry brick walls with the following information:
- Minimum temperature outdoors during the wintertime is (-35°C) and indoor is (+20°C)
  - Maximum wall length L = 24 m
  - Thermal coefficient of masonry brick =  $7.2 \cdot 10^{-6}$  mm/mm/°C
  - Modulus of elasticity of masonry brick E=1.05 GPa
  - the effect of moisture and freezing is neglected
- a) Calculate the minimum expansion joint for the wall for the given temperature variation  
b) Check the thermal stress in the wall without expansion joint
- 4.2 A tensile load of 190 kN is applied to a round metal bar with a diameter of 16 mm and a gage length of 50 mm. Under this load the bar elastically deforms so that the gage length increases to 50.1349 mm and the diameter decreases to 15.99 mm. Determine the modulus of elasticity and Poisson's ratio for this metal.

**Question 5.****(15p)**

- 5.1 A sample of sand has the following properties:
- Absorption coefficient of sand = 1.6%
  - Dry mass of the sample = 589.9 g
  - Moist mass of the sample = 625.2 g
- a) Determine the total moisture content of the sand sample  
b) Determine the free moisture content of the sand.
- 5.2 Coarse aggregate is placed in a rigid bucket and rodded with a tamping rod to determine its unit weight. The following data are obtained:
- Volume of bucket = 10 dm<sup>3</sup>
  - Weight of empty bucket = 9,25 kg
  - Weight of bucket filled with dry rodded coarse aggregate = 27,95 kg
- a) Calculate the dry-rodded unit weight  
b) If the bulk dry specific gravity of the aggregate is 2.630, calculate the percent voids in the aggregate.