

1 Course Information

Status of the Course : Building Technology Major studies; Construction and Maintenance

Level of the Course: Aalto Eng, Master's degree course

Teachers: Prof. Jouni Punkki, and Staff Scientist (D.Sc.), Fahim Al-Neshawy.

Course assistant: Dr.Sc. Anna Antonova and M.Sc. Teemu Ojala.

Teaching Period: Spring 2023 (Period III)

Course Homepage: <https://mycourses.aalto.fi/course/view.php?id=35461>

Registration for Courses: Registration to course using Sisu - <https://sisu.aalto.fi>

Language of Instruction: English

2 Learning Outcomes

Upon successful completion of the course, students will be able to:

Knowledge:

- Gain knowledge about the properties of cement, concrete and special concretes.

Skills:

- Perform the process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible
- Identify properties of concrete in the fresh and hardened states and the effects of mineral and chemical admixtures in concrete
- Theoretically predict the thermal and strength development of concrete structures

General competence:

- Clearly understand the relevant concrete technology
- Identify the chemical or physical process of concrete structures durability concerns, and design their service life.

3 Course Content

The course covers the following topics:

(a) Concrete materials

- Proportioning of concrete mixtures
- Cement hydration process and microstructure of the hydrated cement paste
- Chemical admixtures and Supplementary Cementing Materials (SCMs)
- Interfacial Transition Zone in Concrete (ITZ)

(b) Properties of fresh and hardened concrete

(c) Durability and service life of concrete structures

- Durability of concrete
- Service life design of concrete structures
- Sustainability of concrete

4 Teaching Methods

The course includes the following teaching methods and activities:

- Lectures
- Weekly exercises - **Individual** work
- Laboratory work - Group work and presentations of the laboratory work
- Final written exam

4.1 Lectures schedule (subject to change)

The schedule listed on this page is tentative and may change during the term. We recommend that you use the notes for each lecture and you can add additional notes during class. Recommended readings are listed at - Recommended readings - tab in MyCourses.

Table 1: Course lectures

Day	Date	Lecture	Topic
Mon	9.1.2023	Lecture 1	Introduction to concrete
Tue	10.1.2023	Lecture 2	Cement and hydration
Mon	16.1.2023	Lecture 3	Microstructure of concrete
Tue	17.1.2023	Lecture 4	Mineral admixtures (Supplementary Cementing Materials)
Mon	23.1.2023	Lecture 5	Chemical admixtures for concrete
Tue	24.1.2023	Lecture 6	Properties of fresh concrete
Mon	30.1.2023	Lecture 7	Properties of hardened concrete
Tue	31.1.2023	Lecture 8	Durability - Concrete degradation mechanisms
Mon	6.2.2023	Lecture 9	Durability - Service life design
Tue	7.2.2023	Lecture 10	Sustainability of concrete
Mon	13.2.2023	Seminar - I	Groupwork presentations
Tue	14.2.2023	Seminar - II	Groupwork presentations and Laboratory work results
Thu	16.2.2023	Course review	Course review and general discussion
Mon	20.2.2023	Exam	Final Exam (13:00 - 16:00) at Lecture hall R1

4.2 Weekly exercises - Individual work

The course has four weekly exercises. Students submit their solution (**individually**) into MyCourses system for evaluation within the deadline of each exercise.

The weekly exercises are weighted as 20 % of the final grade.

Table 2: Weekly Exercises

Exercise session	Exercise	Topic
Thu 12.01.2023	01	Concrete Mix-Design methods
Thu 19.01.2023	02	Cement chemistry and microstructure of concrete
Thu 26.01.2023	03	Chemical admixtures and mineral additives
Thu 02.02.2023	04	Heat and strength development
Thu 09.02.2023	05	Carbon footprint and service life design of concrete

4.3 Laboratory work

The main objective of the laboratory work is to design and optimize a concrete mix and predict the heat of hydration and strength development for a given concrete structure. The **hands-on** laboratory work includes mix design, casting, testing of the fresh and hardened concrete and reporting the results. The laboratory work is weighted as 10% of the final grade.

4.4 Final written exam

The written exam includes 5 questions covering the course outcomes. The questions include (short) essay questions and computational question.

The final exam is weighted as 70% of the final grade.

5 Course Workload

Students are assigned work to be completed the course. Students have 2 lectures each week, weekly exercises, laboratory work and presentations and several hours of reading to prepare for the final exam.

Table 3: Estimated course workload

Student activities	#	Time factor (h)	Workload (h)
Attending lectures and readings handouts	10	4	40
Attending seminars and presenting the laboratory work	2	4	8
Attending weekly exercise sessions and exercise work	4	5	20
Group work			
Laboratory (Mix design, casting and testing)	3	5	15
Independent reading (articles, book chapters, lecture notes etc. i.e., preparing for the exam)	1	50	50
Final examination	1	3	3
Total workload (Hours)			136
ECTS Credit of the course (workload / 27)			5

6 Assessment Methods and Grading Scale

The grading scale for course is: 5 (highest); 4; 3; 2; 1 (lowest passing grade); 0 (failed). The course outcome assessment includes:

- a) Weekly exercises - 20% of the final grade (20 points)
- b) Laboratory work - 10% of the final grade (10 points)
- c) Final exam - 70% of the final grade (70 points)

You have to collect at least 50 points from all activities to get the passing grade of 1.

Table 4: Course grading

Total points	Grade
< 50	0
50 .. < 60	1
60 .. < 70	2
70 .. < 80	3
80 .. < 90	4
90 .. 100	5

7 Study Materials

Recommended Book:

P. Kumar Mehta, Paulo J. M. Monteiro (2006). Concrete : microstructure, properties, and materials. New York, NY : McGraw-Hill ; London, cop. 2006.

(Quick search at: <https://www.aalto.fi/en/learning-centre>)

- Chapter 02 - Microstructure of concrete
- Chapter 06 - Hydraulic cement
- Chapter 07 - Aggregates
- Chapter 08 - Admixtures
- Chapter 09 - Proportioning concrete mixtures
- Chapter 10 - Concrete at Early Age
- Chapter 12 - Progress in concrete technology (special types of concrete)
- Chapter 05 - Durability

Optional book in Finnish:

BY 201 Betonitekniiikan oppikirja 2018. Julkaisijat: Suomen Betoniyhdistys r.y. Kustantaja: BY-koulutus Oy. Julkaistu: 2018.

Course handouts:

include explanatory notes and exercise problems.

8 Prerequisites

- CIV-E1010 Building Materials Technology 5 op