# 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:** M.Sc. Teemu Ojala.
**Teaching Period:** Spring 2019 (Period III)
**Course Homepage:** https://mycourses.aalto.fi/course/view.php?id=20507
**Registration for Courses:** Registration to course using WebOodi - https://oodi.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 and recycling of concrete

# 4 Teaching Methods

The course includes the following teaching methods and activities:

- Lectures
- Weekly exercises - **Individual** work
- Laboratory work - **Group** work
- Seminar presentation (assignments) - **Group** 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 | 7.1.2019 | Lecture 1 | Introduction to concrete |
| Wed | 9.1.2019 | Lecture 2 | Cement and aggregates |
| Mon | 14.1.2019 | Lecture 3 | Microstructure of concrete |
| Wed | 16.1.2019 | Lecture 4 | Chemical admixtures for concrete |
| Mon | 21.1.2019 | Lecture 5 | Supplementary cementing materials |
| Wed | 23.1.2019 | Lecture 6 | Properties of fresh concrete |
| Mon | 28.1.2019 | Lecture 7 | Properties of hardened concrete |
| Wed | 30.1.2019 | Lecture 8 | Concrete degradation mechanisms |
| Mon | 4.2.2019 | Lecture 9 | Durability and Service life design |
| Wed | 6.2.2019 | Lecture 10 | Sustainability and Recycling of concrete |
| Mon | 11.2.2019 | Seminar - I | Laboratory work presentations |
| Wed | 13.2.2019 | Seminar - II | Laboratory work presentations |
| Mon | 18.2.2019 | Exam | Final Exam (13:00 - 16:00 at 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 12 % of the final grade.

Table 2: Weekly Exercises

| Date | Exercise | Topic | Deadline |
|---|---|---|---|
| Thu 10.01.2019 | 01 | Mix-Design methods and cement chemistry | Thu 17.01.2019 @ 12:00 |
| Thu 17.01.2019 | 02 | Microstructure of concrete and admixtures | Thu 24.01.2019 @ 12:00 |
| Thu 24.01.2019 | 03 | Heat and strength development | Thu 31.01.2019 @ 12:00 |
| Thu 31.01.2019 | 04 | Durability and Service life design | Thu 14.02.2019 @ 12:00 |

### 4.3 Laboratory work - group work (Problem-based learning (PBL))

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 laboratory work includes mix design, casting, testing of the fresh and hardened concrete and reporting the results.
The laboratory work is weighted as 8% of the final grade.

### 4.4 Seminar presentation (assignments) - group work

Student groups will be provided with assignment topics from real research projects at the begin- ing of the course. Groups are asked to prepare a PowerPoint presentation at the course seminar. The presentation is max. 12 slides length and the presentation time is about 20 min.
The laboratory work is weighted as 5% of the final grade.

### 4.5 Final written exam

The written exam includes 5 questions covering the course outcomes. The questions include three (short) essay questions and two computational question.
The final exam is weighted as 75% of the final grade.

## 5 Course Workload

Students are assigned work to be completed the course. Students have 2 lectures each week, weekly assignments, presentation at the course seminar and several hours of reading to prepare for the final exam.

Table 3: Estimated course workload

| Student activities | # | Time factor (h) | Workload (h) |
|---|---|---|---|
| Lectures | 10 | 2 | 20 |
| Weekly exercises | 4 | 5 | 20 |
| **Group work** | | | |
| Laboratory (Mix design, aggregate grading, casting and testing) | 4 | 5 | 20 |
| Seminar presentation (preparing and presenting) | 1 | 12 | 12 |
| Independent reading (articles, book chapters, lecture notes etc.) | 1 | 60 | 60 |
| Final examination | 1 | 3 | 3 |
| Total workload (Hours) | | | 135 |
| 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 - 12% of the final grade
b) Laboratory work - 8% of the final grade
c) Seminar presentation - 5% of the final grade
d) Final exam - 75% of the final grade

For passing the course, (minimum 37.5/75) points are required from the exam and (minimum 12.5/25) points from exercises, laboratory work and seminar presentation.

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

**Course 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://learningcentre.aalto.fi/en/)

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 Betonitekniikan oppikirja 2018. Julkaisijat: Suomen Betoniyhdistys r.y. Kustantaja: BY-koulutus Oy. Julkaistu: 2018.
Availabe at The Aalto University Library at: https://aalto.finna.fi/Record/alli.792791

**Course handouts:**
include explanatory notes and exercise problems.

# 8 Prerequisites

- CIV-E1010 Building Materials Technology 5 op