



## Course Syllabus

22.4. – 6.6.2024

### 1. Course information

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

Level of the Course: Aalto Eng., Master and postgraduate degree course

Teachers in charge: Prof. Jouni Punkki  
Staff Scientist, Fahim Al-Neshawy, D.Sc.  
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Teaching Period: Spring 2024 (Period V)

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

Language of Instruction: English

## 2. Learning Outcomes

The goal of the course is to familiarize students with advanced experimental and characterization techniques commonly used in construction engineering.

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

- 1) Distinguish the basic conceptual, theoretical and analytical tools necessary for experimental testing of the building materials and structures.
- 2) Explore theoretical and practical information for the common non-destructive and destructive testing methods and techniques for building materials and structures.
- 3) Gain experience with and understanding of the advantages and applications of common experimental field and laboratory testing methods.
- 4) Be able to plan a suitable experimental testing program for building materials and structures.

## 3. Course Content

The course covers the following topics:

- Physical nature of the material property or discontinuity to be inspected.
- Visual inspection of structures.
- Non-destructive testing (NDT), destructive testing (DT) and evaluation techniques.
- Microstructure analysis of building materials – Petrographic analysis, microscopy analyses and computed tomography
- Digital Image Processing (DIP) and Digital Image Correlation (DIC) in Civil Engineering

## 4. Teaching methods

The course includes the following teaching methods and activities:

- 1) Lectures
- 2) Course assignment (group work)
- 3) Field measurements
- 4) Final exam

#### 4.1 Lectures – covers the course content

The course lectures will be held at R 265 at the civil engineering department and the lecture schedule is presented in Table 1. The schedule listed in the table is preliminary and may change during the course.

Table 1. Course lectures and field training sessions.

Date		Topics	
Mon	22.04.2024	12:15 - 14:00	Introduction to experimental testing methods
Wed	24.04.2024	10:15 - 12:00	Condition assessment of concrete structures
Thu	25.04.2024	12:15 - 14:00	<b>Field training session 01: Visual inspection of concrete structures</b>
Mon	29.04.2024	12:15 - 14:00	Electromagnetic testing techniques
Wed	01.05.2024	<b>Holiday</b>	<b>Vappu - 1st of May</b>
Thu	02.05.2024	12:15 - 14:00	<b>Field training session 02: GPR, Concrete cover meter</b>
Mon	06.05.2024	12:15 - 14:00	Moisture measurement in building materials
Wed	08.05.2024	10:15 - 12:00	Destructive measurements on cores (Strength and Porosity)
Thu	09.05.2024	<b>Holiday</b>	<b>Ascension Thursday (Helatorstai)</b>
Mon	13.05.2024	12:15 - 14:00	Electrochemical testing techniques
Wed	15.05.2024	10:15 - 12:00	Ultrasonic testing techniques
Thu	16.05.2024	12:15 - 14:00	<b>Field training session 03: AFRY excursion</b>
Mon	20.05.2024	12:15 - 14:00	Thin section analysis (Petrography)
Wed	22.05.2024	10:15 - 12:00	Microstructure image analysis - Scanning electron microscope (SEM) and Computed tomography ( $\mu$ CT)
Thu	23.05.2024	12:15 - 14:00	<b>Field training session 04: Rebound Hammer, UPV, iCor device</b>
Mon	27.05.2024	12:15 - 14:00	Chemical analysis - Thermogravimetric analysis (TGA), X-ray fluorescence (XRF) and X-ray diffraction (XRD) spectroscopy
Wed	29.05.2024	10:15 - 12:00	Digital Image Processing (DIP) and Correlation (DIC)
Thu	30.05.2024	12:15 - 14:00	<b>Course seminar - Presentations</b>
Thu	06.06.2024	9:00 - 12:00	Course examination

The course also includes a demonstration of most of the non-destructive devices covered in the course (available from the laboratory). The demonstration sessions will be on Thursdays from 12:15 – 14:00.

#### 4.2 Course assignment (group work)

The main objective of the assignment is to enable students to perform mainly non-destructive testing NDT measurement and data analysis of building materials (mainly concrete structures) and combine knowledge with practice. Groups of four students are asked to prepare a written report about a particular NDT device, performed measurements and data analysis. The assignment groupwork value is **30% of the final grade**.

#### 4.3 Field training sessions

The course includes field measurements using some non-destructive testing NDT devices available in the laboratory. Students are asked to submit reports about the used device(s) including (i) principle of the measurement, (ii) measurement procedure and (iii) measurement data and simple analysis of the results. The field measurement reports (students can select only 5 devices) value is **10% of the final grade**.

#### 4.4 Final exam

The written exam includes 4 questions covering the course outcomes. The exam value is **60% of the final grade**.

## 5. Course Workload

Student workload include attending the lectures, excursions, seminars, participating the group work, writing learning (reflecting) diaries and self-study work. The course ETCS/workload is presented in the following table.

*Table 2. Course workload – estimated.*

Student activities	Quantity	Duration (Hour)	Total workload (Hour)	Total hours	Portion %
Individual work - <u>Exam</u>					
Lectures including guest lectures	11	2	22		
Course excursion	1	2	2		
Independent reading for the exam	1	54	54		
Final examination	1	3	3	81.0	60
Individual work - <u>NDT measurements</u>					
Field measurements - sessions	4	2.0	8	14.0	10
Data analysis and reporting	4	1.5	6		
Group work - <u>Course assignment</u>					
Assinment work (group meeting, discussions etc.)	3	2.5	7.5	40.5	30
Writing the assignment report	1	33	33		
Total workload (Hours)			135.5		
ECTS Credit of the course (workload / 27)			5		

## 6. Assessment methods and grading scale

The total points of the course are 100 and the grading scale for course is: 5 (highest); 4; 3; 2; 1 (lowest passing grade); 0 (failed). For passing the course, a minimum of (50) points are required.

*Table 3. Course grading*

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

## 7. Study Materials

- Recommended book for the course:
  - Jean-Paul Balayssac and Vincent Garnier, (2017). Non-Destructive Testing and Evaluation of Civil Engineering Structures. <https://ebookcentral.proquest.com/lib/aalto-ebooks/detail.action?docID=5165459>
    - Chapter 2. Ultrasonic Methods
    - Chapter 3. Electromagnetic Methods
    - Chapter 5. Electrochemical Methods
    - Chapter 9. Applications In Situ
    - Chapter 10. Methodological Guide
- Course handouts: include slides from lectures, explanatory notes, and additional readings.

## 8. Prerequisites

- CIV-E1010 Building Materials Technology
- CIV-E2020 Concrete Technology
- CIV-E2060 Production technology of concrete structures