

Module Template for New and Revised Modules

Module Code	CEU44A01 / CEP55E05
Module Name	CIVIL ENGINEERING MATERIALS
ECTS Weighting¹	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Prof Sara Pavia
<u>Module Learning Outcomes</u> with reference to the <u>Graduate Attributes</u> and how they are developed in discipline	<p>On successful completion of this module, students should be able to:</p> <p>LO1. Understand low-carbon cements and low-carbon geopolymers as Portland cement replacements.</p> <p>LO2. Recognise the potential of geopolymer cements, reactive wastes, pozzolans and SCMs (supplementary cementitious materials) to lower the carbon impact of construction.</p> <p>LO3. Appreciate and understand sustainable materials and sustainable methods of construction.</p> <p>LO4. Critically interpret the results of engineering testing and scientific material analyses.</p> <p>LO5. Identify, analyse and solve problems relating to the durability and environmental impact of materials in constructions. Select the most appropriate materials for a particular use.</p> <p>LO6. Categorise non-structural cracking and corrosion phenomena in PC concrete and plan for their minimization or avoidance.</p> <p>LO7. Develop a regime for investigation of problems and deterioration and evaluate the quality and durability of building materials.</p> <p>LO8. Interpret and communicate effectively the results of research and laboratory experimentation.</p> <p>LO9. Practice high professional and ethical standards in relation to sustainable materials and the selection of quality, sustainable materials for building.</p> <p>L10. Understand the carbon impact of materials and construction.</p>

Graduate Attributes: levels of attainment

To act responsibly – LO 11, 8, 3,1.
To think independently – LO 7, 6, 5,2, 1.
To develop continuously – LO 10, 4, 1.
To communicate effectively – LO 9, 3,1.

Module Content

The module provides the student with essential knowledge on the properties, use, deterioration and repair of some of the most important materials used for building including:

- Geopolymers and other low-carbon cements.
- Use of reactive wastes as cementing materials.
- LCA (life cycle assessment) of materials and construction.
- Sustainable materials and construction: Earth, hemp-lime concretes. Thermal/hygric properties. Production and use.
- Insulation: Lime renders, cork and hemp materials, aerogels and CSB. Thermal/hygric properties. Application.
- Building limes. Masonry mortars. Pozzolans. Repair mixes.
- PC concrete: Constituents, additives, admixtures. Durability, corrosion, cracking. Properties: strength, thermal and moisture movement.
- Stone: Origin, properties and durability. Testing, quality control. Introduction to cleaning and restoration.
- Clay brick and ceramics. Composition and manufacturing technology. Vitrification. Decay/defects.
- Timber: Hardwoods and softwoods. Structural timber. Laminates. CLT. Properties and decay.

Teaching and Learning Methods

Lectures, laboratories and site visits.

The teaching strategy is a mixture of:

- Lectures (27 hours),
- laboratory practical's and site visits (12 hours),
- research reports.

Assessment Details²

Please include the following:

- **Assessment component**
- **Assessment description**
- **Learning outcome(s) addressed**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Examination	2 hour written exam	LO1- LO7	80%	April/May, as published by the exams office
Coursework	Technical reports	LO8-LO11	20%	Week 10

Reassessment Requirements	2 hour 100% written examination
Contact Hours and Indicative Student Workload²	<p>Contact hours: lectures 27 hours; laboratories and sites 12 hours.</p> <p>Independent Study (preparation for course and review of materials): 60 hours</p> <p>Independent Study (preparation for assessment, incl. completion of assessment): 30 hours</p>
Recommended Reading List	<ul style="list-style-type: none"> Download publications on cements, insulation, earth construction, lime-hemp concrete, lime-based materials from: https://www.tcd.ie/research/profiles/?profile=pavias <i>Stone, Brick and Mortar.</i> S. Pavía and J. Bolton. (2000) Wordwell. Bray. <i>Permeability and Porosity of Hardened Concrete.</i> R. West. (1997). In: Concrete—an essential update. Module I: Essential characteristics of concrete. IEI and ICS. <i>Thermal and Shrinkage Movements.</i> R. West. (1997). In: Concrete—an essential update. Module 2: Essentials of early age concrete. IEI and the Irish Concrete Society.
Module Pre-requisite	Basic knowledge on Chemistry / Materials.
Module Website	https://www.tcd.ie/Engineering/undergraduate/baiyear4/modules/4A1.pdf
Academic Start Year	2026
Academic Year of Date	2025-26