



<b>Course Code</b> CEE-152	<b>Course Title</b> Construction Materials	<b>ECTS Credits</b> 7
<b>Department</b> Engineering	<b>Semester</b> Spring	<b>Prerequisites</b> None
<b>Type of Course</b> Required	<b>Field</b> Civil & Environmental Engineering	<b>Language of Instruction</b> English
<b>Level of Course</b> 1 <sup>st</sup> Cycle	<b>Year of Study</b> 1 <sup>st</sup>	<b>Lecturer(s)</b> Dr Panayiotis Polycarpou
<b>Mode of Delivery</b> Face-to-face	<b>Work Placement</b> N/A	<b>Co-requisites</b> None

### Objectives of the Course:

The main objectives of the course are to:

1. Acquire fundamental knowledge about the nature and behavior of the most common construction materials.
2. Develop the judgment to select the suitable materials that fulfill the basic design requirements for the structures.
3. Get familiar with laboratory and field testing procedures for the verification of the physical and mechanical properties of the various construction materials.
4. Provide a foundation for the application and practice of materials technology science.

### Learning Outcomes:

Upon completion of the course, the student should be able to:

1. Demonstrate understanding of the basic mechanical properties of solids
2. Identify the physical and mechanical properties for most commonly used building materials, as well as for some contemporary advanced construction materials.
3. Describe and conduct the necessary experimental work for the quality control and the verification of certain material properties
4. Evaluate, analyze and interpret the data obtained through standard laboratory testing procedures.
5. Identify the advantages and disadvantages regarding the use and performance of each provided construction material.
6. Identify and suggest typical and potential applications of these materials
7. Efficiently select the suitable material for a given application, considering the various factors that affect or/and determine this selection.

## Course Contents:

**Introduction** to and classification of the various construction materials and their major applications. Basic requirements of the civil engineering materials. Relevant knowledge required from a civil engineer.

**Introduction to mechanical properties of solids.** Loading. Stress. Strain. Tension. Compression. Shear. Units of measurement. Stress-strain relationship (linear, non-linear). Elastic and non-elastic behavior. Modulus of Elasticity. Poisson effect. Plastic deformation. Ductility. True stress, true strain. Creep and relaxation. Fatigue. Tensile test. Charpy test. Material properties variability. Definition of characteristic strength.

**Cements.** Hydraulic cement. Portland cement. Raw materials and manufacturing process. Chemical composition. Hydration of cement. Structure and strength of hardened cement paste. Water-to-cement ratio effect. Pores and water presence in pores.

**Cement additions.** Inert additions. Pozzolanic additions. Mode of action and pozzolanic behaviour. Common additions used in the industry.

**Admixtures.** Plasticisers, Superplasticisers, Accelerators, Retarders, Air-entraining agents. Mode of action of each admixture. Benefits and drawbacks. Applications.

**Aggregates for concrete:** Types of aggregates and classification. Shape and size classification methods. Sieve analysis test. Definition of specific gravity, bulk density, strength, porosity and absorption of aggregates.

**Concrete:** Constituent materials. Applications overview. Order of operations for concrete. Production methods. Transporting, handling and placing principles. Properties of fresh concrete and related tests. Early age properties, plastic settlement, drying shrinkage, curing, strength gain and temperature effects. Creep in concrete. Strength and failure of hardened concrete. Laboratory tests. Non-destructive and in-situ testing. Factors influencing strength. Concrete mix design. Durability issues: related properties, tests, and major degradation agencies. Special concretes.

**Steel.** Raw materials and manufacturing processes. Types of steel used in construction: Hot-rolled structural steels, Cold-formed steel, Reinforcing steel. Major properties. Quenching and tempering. Grading of steel. Joining methods. Durability issues. Corrosion. Testing of steel.

**Aluminium.** Applications in construction. Raw materials and manufacturing processes. Aluminium alloys. Durability issues.

**Bituminous materials.** Applications, with emphasis in road construction. Sources of bitumen. Main characteristics of bitumen. Types of bitumen products. Viscosity and rheology of binders. Grades of bitumen. Basic test for assessing the main properties of bitumen. Requirements for and testing of aggregates used in asphaltic mixtures. Types of bituminous mixtures. Mixing (production) methods. Durability of bituminous structures. Ageing tests.

**Masonry:** Types of masonry. Major types of masonry units used in construction.

Fired clay units: raw materials and manufacturing methods, physical and mechanical properties. Relevant tests. Concrete units. Aircrete units. Mortars. Mortar properties and testing. Basic mechanical properties and structural performance of masonry structures. Reinforced masonry.

**Timber.** Types of wood and production process. Structure of timber. Defects in wood. Effects of moisture. Physical and mechanical properties. Common tests. Grades of timber. Durability issues and preservation techniques.

**Composites.** Types: Macroscopic, Microscopic, Fiber-Reinforced, Particle-Reinforced composites. Properties. Application examples in civil engineering and construction. Advantages and disadvantages.

**Selection and sustainable use of construction materials.** Factors affecting the selection of appropriate construction materials. Environmental issues. Sustainable use of construction materials. Life-cycle assessment procedure. Recommendations for green construction.

**Laboratory work:** The laboratory sections are designed to provide students a hand-on experience on various material testing concepts and procedures. A list of such laboratory tests that are designed for this course is provided below:

- Sieve analysis and grading of aggregates
- Concrete mixing
- Fresh concrete slump test
- Making and curing specimens for strength test
- Non-destructive testing of concrete strength
- Compression test of concrete specimens and masonry units
- Flexure test of concrete specimens
- Tensile test of metal rods

**Learning Activities and Teaching Methods:**

Lectures, Example problems, Laboratory, Projects, Discussion

**Assessment Methods:**

Homework, Project assignments, Lab-reports, Mid-term exams, Final exam.

**Required Textbooks/Reading:**

Authors	Title	Publisher	Year	ISBN
Peter Domone and John Illston	Construction: Materials, 4 <sup>th</sup> Edition	CRC Press	2010	978-0415465168

**Recommended Textbooks/Reading:**

Authors	Title	Publisher	Year	ISBN
M.S. Mamlouk and J.P. Zaniewski	Materials for Civil and Construction Engineers	Pearson	2013	9781292026053
Haimei Zhang	Building Materials in Civil Engineering	Woodhead Publishing Ltd	2011	978-1845699550