UCLouvain

# lgciv1031

*2023*

# Structural Materials and Geomaterials

| 5.00 credits | 30.0 h + 30.0 h | Q2 |
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| Teacher(s) | Rattez Hadrien ;Saraiva Esteves Pacheco De Alm João ; |
| Language : | French |
| Place of the course | Louvain-la-Neuve |
| Prerequisites | Basic notions of the mechanics of solids and fluids |
| Main themes | The objective of the course is to study fundamental scientific and technical aspects linked to the understanding and analysis of structural materials and geomaterials in construction.<br>The course aims at providing future engineers with an essential background on mechanics, geomechanics and properties of construction materials that will be useful throughout their study curriculum and professionally when managing civil engineering projects. |
| Learning outcomes | **At the end of this learning unit, the student is able to :**<br>1<br>**Contribution of the course to the program objectives (N°):**<br>AA1.1, AA1.2, AA3.1, AA3.3, AA4.1, AA4.2, AA4.3, AA4,4, AA5.3, AA5.5, AA6.1<br>**Specific learning outcomes of the course**<br>At the end of the course, students will be capable of:<br>• Identify the main categories of materials (ductile, fragile, others), constitutive relations, and fundamental mechanical properties.<br>• Characterizing material stress and strain states, time-dependent behaviour (creep, relaxation, recovery), thermal effects, and accounting for the presence of shear in 2D and 3D.<br>• Understanding the process of failure of ductile and brittle materials and applying suitable yield and failure criteria.<br>• Describing the main physical and mechanical properties of solid materials used in structural engineering (steel, concrete, masonry, wood, etc) and geomaterials.<br>• Establishing the link between theoretical formulations of mechanical properties and their empirical evaluation through laboratory testing.<br>• Identifying the main types of rocks and minerals, and describing their formation processes and the impact on the mechanical, hydraulic and physical properties.<br>• Describing a geological structure based on the reading of a geological map, and the impact of this structure on some civil engineering projects.<br>• Describing and analysing the interaction of water and geomaterials.<br>• Describing and applying the concept of stress in geomaterials |
| Evaluation methods | Attendance of laboratory sessions. Final written examination.<br>The attendance of the laboratory sessions, which constitutes the continuous evaluation grade, cannot be repeated in the second session; the continuous evaluation grade acquired in the first session is retained in the event of a second session.<br>the use of generative artificial intelligence (such as ChatGPT, Consensus, Perplexity, Bard...) is forbidden for this course. |
| Teaching methods | Lectures and exercise sessions in classroom, as well as laboratory sessions at LEMSC. |
| Content | The course is organised in two parts:<br>1. Stress states, constitutive relations, and failure criteria:<br>- Properties and mechanical behaviour of structural materials and geomaterials.<br>- Shear stress and strain, plane stress, principal stress and maximum shear stress, Mohr’s circle for plane stress, triaxial stress, plane strain.<br>- Thermal effects, time-dependent behaviour (creep, relaxation, recovery), stress concentrations, etc.<br>- Failure criteria for ductile and brittle materials: Tresca, Von Mises, Rankine, Mohr-Coulomb, etc. Influence of repeated loading and fatigue.<br>2. Origins and characteristics of main structural materials and geomaterials:<br>- Steel: composition, production, use, properties.<br>- Concrete: composition, use, properties.<br>- Masonry and Wood. |

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| | - Genesis and genetic classification of rocks: igneous rocks, sedimentary rocks, and metamorphic rocks. Main physical properties of rocks. Rock identification. Soil formation.<br>- Interpretation of geological maps.<br>- Physical characterization of soils: Particle size distribution of fine and coarse soils, consistency, soil classification. Volume mass relationships, soil compaction.<br>- Soil-water interaction, capillarity, Darcy law, 1D groundwater flow, laboratory hydraulic conductivity test, introduction to 2D groundwater flow (flownets).<br>- Introduction to quantifying the environmental impact of civil engineering materials using life cycle assessment. |
| Inline resources | Available on Moodle |
| Faculty or entity in charge | GC |

| Programmes containing this learning unit (UE) | | | | |
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| Program title | Acronym | Credits | Prerequisite | Learning outcomes |
| Bachelor in Engineering : Architecture | ARCH1BA | 5 | | |
| Specialization track in Construction | FILGCE | 5 | | |
| Minor in Construction | LMINOGCE | 5 | | |
| Mineure Polytechnique | MINPOLY | 5 | | |