4A1 – Civil Engineering Material [5 ECTS]

Module Co-ordinator(s): Assoc. Prof. Sara Pavia [pavias@tcd.ie]

Lecturer(s): Prof. Brian Broderick, Assoc. Prof. Trevor Orr, Assoc. Prof. Sara Pavia, Mr. Michael Quaide, Assoc. Prof. Roger West.

Module organisation
Department of Civil, Structural and Environmental Engineering

Module description, aims and contribution to programme
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 stone and clay brick, concrete, lime mortar, metals, timber and geotechnical materials.

Learning outcomes
On completion of this module, the student will be able to:
1. Select quality building material, compatible with existing fabrics and responsible towards the environment.
2. Identify, analyse and solve problems relating to the behaviour of building materials in constructions.
3. Select the most appropriate materials needed in order to solve a problem or to be employed for a particular use.
4. Critically interpret the results of engineering testing and scientific analysis of building materials.
5. Differentiate between choices of concrete mix constituents and site process.
6. Categorise non-structural cracking and corrosion phenomena in concrete and plan for their minimization or avoidance.
7. Develop a regime for investigation of material deterioration.
8. Estimate the main properties of clay rick, building stone, grouts and additives to improve the properties of the grouts.
9. Explain the process of soil stabilisation, the main additives used to stabilise soil and the ground conditions for which they are suitable.
10. Assess the environmental impact of the use of geosynthetics, grouts and admixtures in geotechnical engineering.
11. Effectively conduct the relevant experiments and analysis needed in order to evaluate the quality and durability of building materials.
12. Communicate effectively the results of research and laboratory experimentation.
13. Practice high professional standards in relation to the repair and conversation of traditional and historic fabrics.
14. Practice high ethical standards concerning the selection of quality materials for building.
Module content

- **Mortar:**
- **Concrete:**
- **Stone:**
- **Timber:**
- **Brick:**
- **Steel:**
  Manufacture. Corrosion and fire protection.
- **Geotechnical Materials:**
- **Bitumen:**

Teaching strategies

The teaching strategy is a mixture of lectures, laboratory exercises, site visits and research reports. These are designed to improve the student’s ability to appraise and communicate as well as to provide the student with a better knowledge of the practical and experimental aspects of civil engineering materials. The laboratory exercises are designed to allow the students to effectively conduct the experiments and analysis needed in order to evaluate the quality and durability of building materials. The site visits are designed to allow the student to develop a practical knowledge of material production technologies and typical problems with masonry fabrics. Finally, the research reports include a final presentation. These enable the students to employ and express their own initiative in order to interpret and criticise a particular test employed in the laboratory.

Assessment

80% of the assessment is due to a two hour examination held during Trinity Term. The remaining 20% is allocated for practical work divided equally between three technical reports written on the three following exercises: i) a visit to a readymix concrete, blockwork and mortar factory, ii) the cause and severity of non-structural
cracks on campus, iii) three site assessments on the cause and remedy for decay of masonry buildings and a laboratory exercise on the applications of Scanning Electron Microscopy and Energy dispersive X-ray analysis to determine the structure and mineral content of building materials in order to assess quality and diagnose failure.

**Required textbook**