4A1 – Civil Engineering Materials [5 ECTS]

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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 thermal insulation, stone, clay brick, Portland cement concrete, lime mortar, metal and timber.

Learning outcomes
On completion of this module, the student will be able to:
1. Understand the thermal and hygric performance of insulation materials used in construction.
2. Choose thermal retrofitting options compatible with different types of built fabrics.
3. Assess the impact of retrofitting thermal insulation in buildings.
4. Select quality building material, compatible with existing fabrics and responsible towards the environment.
5. Identify, analyse and solve problems relating to the behaviour of building materials in construction.
6. Select the most appropriate material required in order to solve a certain problem or to fulfil a particular function.
7. Critically interpret the results of engineering testing and scientific analysis of building materials.
8. Differentiate between choices of concrete mix constituents and site process.
9. Categorise non-structural cracking and corrosion phenomena in concrete and plan for their minimization or avoidance.
10. Develop a regime for investigation of material deterioration.
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 ethical and professional standards concerning the selection of quality materials for building.
Module content

- Thermal insulation:
  In-situ thermal performance of internal insulations including traditional lime plaster, thermal paint, aerogel, cork lime, hemp lime, calcium silicate board (CSB), timber fibre board, polyisocyanurate (PIR) board and others. Laboratory measured properties. Wall moisture levels and moisture behaviour following the application of insulation, impact on durability.

- Mortar:

- Concrete:

- Stone:

- Timber:

- Brick:

- Steel:
  Manufacture. Corrosion and fire protection.

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.

Further reading
- Download related publications from: https://www.tcd.ie/research/profiles/?profile=pavias

Further information
https://www.tcd.ie/Engineering/