S8 – Concrete Durability & Sustainability, CE7S08 [5 credits]

Module co-ordinator(s): Associate Prof. Roger West, (rwest@tcd.ie)

Lecturer(s): Prof. Ravindra Dhir, Prof. Sara Pavia, Prof Roger P. West

Module Pre-requisites:
Concrete materials course at undergraduate level or Advanced Concrete Technology MSc course in the first semester.

Module organisation
Second: Weeks 1-10
Lectures 27
Assignments 20
Directed learning 20
Autonomous learning 33
Total 100
Note: 1 ETCS is 20 hrs of student effort

Module description, aims and contribution to programme
The module describes the wealth of knowledge which exists in how to design more durable and sustainable concrete, dealing with all the classical durability phenomena and identifying the arguments for and the choice of alternative environmentally friendly materials for use in concrete. The aim is to develop in the student an awareness and understanding of the key facets of durability and sustainability in designing, specifying and using concrete in practice. It builds on the advanced concrete technology concepts developed S5 module in semester 1, but this is not a pre-requisite.

Module content

1. Materials (Prof Pavia, 3 lectures)
1.2 Recycled aggregates: Types, advantages, limitations and standardisation. Effect on concrete properties.
1.3 Bioconcrete: Hemp-lime concrete and other biomaterials.

2. Durability (Prof Dhir, 10 lectures)
2.1 Physical properties of concrete related to durability
2.2 Resistance to destructive agents: Corrosion, carbonation, chloride ingress, sulfate attack, acid attack, alkali silica reaction, pyrites, freeze-thaw damage.
2.3 Corrosion protection: Sacrificial anodes, cathodic protection, desalination
2.4 Design for durability and standards
2.5 Concrete durability specifications
3. Sustainability (Prof West, 6 lectures, Prof Dhir 4 lectures)
3.1 Concrete Constituents: low energy concrete, cement manufacture, cement additions, recycled aggregates
3.2 Carbon footprinting and embedded carbon
3.3 Life-cycle costing including durability, maintenance and re-use of concrete
3.4 Thermal Mass and passive heating
3.5 Off-site concrete construction

4. Case Studies (Guest speakers, 4 hours)
4.1 Guest Speakers from sustainable concrete projects
4.2 Student presentations on sustainable projects

Learning outcomes
On successful completion of this subject the student will be able to:
1. Appreciate the main factors affecting concrete durability
2. Design a concrete to withstand standard exposure classes
3. Demonstrate a deeper understanding of concrete behaviour
4. Understand the issues surrounding concrete sustainability
5. Select optimised solutions to practical problems of durability and sustainability in concrete

Teaching strategies
Core content via lecture (direct)
Regular personalised individual assignments

Assessment
Term Assessment (10%); Examination (90%)

Required textbook
None

Further information
School of Engineering weblink.