Engineering Tripos Part IIB, 4M19: Advanced Building Physics, 2019-20

Module Leader

Prof G.R. Hunt [1]

Lecturers

Prof G.R. Hunt, Dr M. Overend [1]

Timing and Structure

16 lectures (including integrated examples classes) + coursework; Assessment: 100% coursework

Aims

The aims of the course are to:

- To develop a deep understanding of how fundamental principles of building physics are integrated at the system level to guide the design of zero-carbon built environments

Objectives

As specific objectives, by the end of the course students should be able to:

- evaluate alternative energy systems and buildings technologies against energy consumption for a given context.
- design and evaluate novel systems for the low-energy built environment.
- operate equipment and capture data to assess building performance.
- use field measurements to validate building performance models.
- understand the factors that influence and control the movement of air and heat in naturally ventilated buildings.

Content

Designing sustainable buildings requires making choices among various building materials and components, and more efficient use of energy and natural resources. In order to do so, the building structure, the building fabric and the building services must be understood both in individual detail and as interacting systems. For example, the need for energy must be analysed in conjunction with energy production for heating and cooling, distribution, thermal storage and the end-use in buildings. The module first introduces students to energy-efficient building systems and other advanced building physics topics. It subsequently describes energy modelling techniques for analysing buildings as a system of interacting components and processes leading to low-energy buildings that satisfy occupant comfort systems and technologies. The module aims to develop a deep understanding of how fundamental principles of building physics are integrated at the system level to guide the design of zero-carbon built environments.

Energy Efficient Building Systems & Building Performance Modelling (6 hours, Dr M. Overend/A. Luna-Navarro)

- Introduction to energy-efficient building systems

- Building envelope systems
- Light and lighting systems
- Occupant comfort and behaviour

Ventilation: creating air movements for the supply of fresh air and removal of stale air (10 hours, Prof. G.R. Hunt)

- Natural ventilation of modern buildings
- Displacement ventilation & thermally stratified flows
- Mixing ventilation
- Airflow through vents
- Transient flows through rooms & night purging
- Steady flows through rooms & heat source modelling
- Sizing ventilation openings
- Low-energy design

Further notes

Examples papers

Coursework

Students will undertake two tranches of coursework that are both aimed at assessing the performance of an indoor space in terms of energy efficiency and occupant comfort. The first coursework, drawing directly from the

ventilation lectures, consists of an in-class exercise to map out (qualitatively and quantitatively)

the preliminary design of a low-energy, naturally ventilated building. This exercise is assessed in

class and is therefore not graded anonymously. The second coursework consists of field

measurements within specified rooms, where the students will use a range of instruments for characterising environmental performance and comfort levels. The students will subsequently use the experimental data from their work to develop evidence-based proposals for improving the energy efficiency and comfort within the indoor space.

The second coursework will be submitted at the start of Lent Term.

- Report 1: Preliminary design of a low-energy, naturally ventilated building
- Report 2: Performance assessment of real-world space based on field measurements

Coursework	Format
Coursework activity #1 Report 1 Preliminary design of a low-energy, naturally ventilated building	In-class e Assessed
Coursework activity #2 Report 2 **Performance assessment of real-world space based on field measurements**	Individua Anonym

Booklists

Please see the Booklist for Group M Courses [2] for references for this module.

Examination Guidelines

Please refer to Form & conduct of the examinations [3].

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Links
[1] mailto:grh20@cam.ac.uk
[2] https://www.vle.cam.ac.uk/mod/book/view.php?id=364101&chapterid=56291
[3] http://teaching.eng.cam.ac.uk/content/form-conduct-examinations