Engineering Tripos Part IIB, 4D13: Architectural Engineering, 2018-19

Module Leader (Engineering)

Dr R Choudhary [1]

Module Leader (Architecture)

Dr M Ramage [2]

Lecturers

F A McRobie, S Smith, S. Fitzgerald

Timing and Structure

Michaelmas term. 8 afternoons. Assessment: 100% coursework

Prerequisites

[3D3, 3D4, 3D8] useful

Objectives

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

- have some appreciation of the principles of architectural engineering, with a strong focus on environmental and structural aspects.
- be aware of the various functional requirements of building services and building envelopes, and of how they can be met by combinations of materials and proper construction techniques.
- be aware of current digital and computational techniques used in design analysis.
- design using timber

Content

This module is run in conjunction with the Department of Architecture. CUED students who elect to do this module will work together one full afternoon per week with final year students from the Department of Architecture. The module involves an architectural engineering design exercise, with students working in mixed groups of architects and engineers.

The course focuses on energy-efficient building designs. It also considers structural design -- specifically timber.

Mich 2017 exercise was on designing tall timber buildings. Projects vary from year to year.

The teaching format will be unconventional. Each afternoon will probably begin with a talk by one of the lecturers or by an external speaker. For the remaining class time, students will work (in groups) on developing environmental, structural and other strategies for their design project.

On week 6 of the course, each group will make a presentation of its design (including a physical model) to an assembled group of architectural, structural, environmental experts. Weeks 7-8 will be devoted to developing

detailed design of parts of the project, with students working on their individual reports.

Course Schedule

All classes will be in LR3, Inglis Building, Engineering Dept., 2.00-5.00pm Thursdays.

1. Thursday 4th October

Course Introduction

- **Lecture 1: Supertall Timber (Michael Ramage)**
- Teams will be formed and the following **Project Tasks** distributed:

A: Precedent timber construction materials

B: Precedent Tall Buildings

C: Exemplary Tall Timber buildings

D: Exemplary timber building (not necessarily tall)

E: Fire Safety in tall buildings

F: Ventilation of tall buildings

G: Energy efficiency and sustainability of tall buildings

H: Façade Design of Tall Buildings

J: Daylighting and solar control of tall buildings

K: Site: analysis of climate data of London

L: Site: Digital 3D Model of the Site & Urban Context

M: PassiveHaus and other Energy Efficiency Standards

N: Site: Solar & daylighting Analysis

N: Site: Local Air Movement Analysis

O: Urban Design Analysis of the Site

Teams will upload their documentation by 2 pm, 11th October onto Moodle.

2. Thursday 11th October

- **Lecture 2: Timber Engineering (Ed Moseley, Director of Adams Kara Taylor AKT II)**
- Group work

Project Tasks Due (5% mark)

3. Thursday 18th October

- **Lecture 3: Passive house principles in tall buildings (Ivan Jovanovich, Associate Director of Atelier Ten)**
- Group work

4. Thursday 25th October

- **Lecture 4: Urban design lecture (Kevin Flanagan, PLP Architecture)**
- Group work

5. Thursday 1st th November

- **Lecture 5: Daylighting & Energy Efficiency (Ruchi Choudhary)**
- Group Work

6. Thursday 8nd November

- **Design Review (20% mark)** Critics: Ron Baker, Kevin Flanagan, Ed Moseley, Simon Smith, Shaun Fitzgerald, Michael Ramage, Ruchi Choudhary, Allan McRobie, Meredith Davey

7. Thursday 15th November

- **Workshop 1: Ventilation Design of tall buildings** (Prof. Shaun FitzGerald, Royal Academy of Engineering Visiting Professor)

8. Thursday 22rd November

- **Workshop 2: Structural Detailing of Timber Buildings** (Simon Smith, Smith & Wallworks)

Coursework

Coursework:

- 5% for week 1 group exercise

- 20% for the group presentation of the design and the model on week 6

- 15% for technical manual on 26/11/2018

- 60% for an individually authored report on developing an aspect of the design and analysis, to be submitted digitally on Moodle by each student by 4.00pm on the first day of the Lent Term.

Task		
Wiki Site (5% mark)	Each team will upload assigned task to the moodle site. Marks will be based on quality and clarity of	
Design Review (20% mark)	Each group will orally present their design proposal, with 2 posters (A1 size) and a model of their bu and/or visual materials to present their design.	

	Designs will be judged on creativity and feasibility of the proposal.	
Technical Manual (15% mark)	Each group will submit a report of 4 A4 size pages describing technical elements of their design (eg. energy efficiency). Think of this as a “development proposal brochure” – it has to cover the necessa	
Individual Report (60% mark)	A report of 4 A4 size pages showing detailed analysis and outcomes of one selected element of the should clearly explain all relevant assumptions, numerical results, technical figures, with appropriate The 4 page report should be complete in itself, and any additional material in the appendices should Secondary but relevant material may be included in the appendices. Think of this as the detail to accompany the previous “brochure” – if you put all of your group’s repor describe your proposal in detail.	

Booklists

Please see the **Booklist for Group D Courses** [3] for references for this module.

Examination Guidelines

Please refer to Form & conduct of the examinations [4].

UK-SPEC

This syllabus contributes to the following areas of the UK-SPEC [5] standard:

Toggle display of UK-SPEC areas.

GT1

Develop transferable skills that will be of value in a wide range of situations. These are exemplified by the Qualifications and Curriculum Authority Higher Level Key Skills and include problem solving, communication, and working with others, as well as the effective use of general IT facilities and information retrieval skills. They also include planning self-learning and improving performance, as the foundation for lifelong learning/CPD.

IA1

Apply appropriate quantitative science and engineering tools to the analysis of problems.

IA2

Demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs.

KU1

Demonstrate knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics.

KU2

Have an appreciation of the wider multidisciplinary engineering context and its underlying principles.

D1

Wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations.

D2

Understand customer and user needs and the importance of considerations such as aesthetics.

D4

Ability to generate an innovative design for products, systems, components or processes to fulfil new needs.

D5

Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal.

D6

Manage the design process and evaluate outcomes.

S3

Understanding of the requirement for engineering activities to promote sustainable development.

S4

Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.

E1

Ability to use fundamental knowledge to investigate new and emerging technologies.

E2

Ability to extract data pertinent to an unfamiliar problem, and apply its solution using computer based engineering tools when appropriate.

E3

Ability to apply mathematical and computer based models for solving problems in engineering, and the ability to assess the limitations of particular cases.

E4

Understanding of and ability to apply a systems approach to engineering problems.

P1

A thorough understanding of current practice and its limitations and some appreciation of likely new developments.

P3

Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology, development, etc).

P4

Understanding use of technical literature and other information sources.

P6

Understanding of appropriate codes of practice and industry standards.

US1

A comprehensive understanding of the scientific principles of own specialisation and related disciplines.

US3

An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.

US4

An awareness of developing technologies related to own specialisation.

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Links
[1] mailto:rc488@cam.ac.uk
[2] mailto:mhr29@cam.ac.uk
[3] https://www.vle.cam.ac.uk/mod/book/view.php?id=364101&chapterid=52231
[4] https://teaching.eng.cam.ac.uk/content/form-conduct-examinations
[5] https://teaching.eng.cam.ac.uk/content/uk-spec