

CE 113 CREATIVE DESIGN (1)

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Lecturers: Professor Chris Wise (CMW)
Mr. Ed McCann (EMcC)

Structure: 40 contact hours in 10 afternoon workshops

Links: see syllabus

Introduction

The course explores essential engineering skills. It begins with simple project-based learning about the approach to design, evolving into designs of real engineering projects. All projects are in group format. The aim is give insight and practice in the role of the engineer as designer.

Language

The language of the course is engineering, in English. Students are expected to develop and use appropriate simple engineering language from the start. Chris and Ed will not spend time explaining everyday engineering language to students at the expense of time for other students. In order that the supervisors can understand problems, issues and progress, all group work must be conducted in English. All students are directed to the BS in the reading list for help with engineering language.

Aims

- to put design into an engineering context, and to practice it
- to allow students to “map” the relevance of the other subjects taught at Imperial.
- to give students an insight into how they can develop the broad-based skills needed for engineering in practice.
- to discover and develop “soft” skills such as creativity, communication, group interaction, listening, interpretation, decision making, charm, toughness, patience, persuasion, ability to deal with criticism, and an understanding of broad context.
- to complements the “hard” analytical and theoretical knowledge learned in the rest of the syllabus.
- to experience and practice group working, aimed at giving an insight into the world of real-life project teams.

Learning Outcomes

By the end of the course, students should:

- understand what engineering is, what engineers do, and how they do it.
- know how to communicate engineering design with clarity and confidence.
- be able to demonstrate the key skills of engineering synthesis, analysis, and judgement
- know how to develop and run complementary teams in which everyone works to their strengths and covers each others' weaknesses.
- understand the ingredients of the project process and know where the various parts of the M.Eng curriculum fit into it.

Frequent practice, feedback and constructive criticism are the means.

These skills, learnt during the 1st and 2nd year design modules, provide a thread of creative engineering design relevant to all four years of the degree course especially CE315.

Means

A number of key themes underpin the course, and you will be given regular opportunities to practice them:

Engineering is “the art of changing the physical world for the use and benefit of mankind”

and it is a fantastic privilege for engineers to be entrusted to do that.

Design is to “conceive and plan out in the mind” (OED).

Design is an essential activity of engineering without which, we believe, you cannot be an engineer.

Design is “the turbocharged application of experience” Renzo Piano.

If you want to be a good engineering designer, you need to direct your life towards gaining lots of relevant experience and learn how to apply it to engineering in a turbocharged fashion (remembering that you need a driving licence first).

What is relevant experience and how do I gain it?

You will gain some relevant experience during your formal study in the rest of the M.Eng course. You can only find out whether it is relevant by trying to use it. Creative Design gives you the chance to practice that, and to weave in your life experience from everywhere else. It also gives you the chance to work together in teams to pool your experiences.

What happens during a project?

All projects follow a similar process. Ideas emerge...from somewhere....and when they do we test them. Some tests are based on personal experienceperhaps we recognise the idea, perhaps we just like it. Some are based on our specific understanding of the project, which improves by the minute. Ideas that ‘fail’ these tests may be dumped, parked for reuse, or modified and retested. Ideas that ‘pass’ these early tests are given a more recognisable examination....engineering analysis, calculations, a physical model, a consultation, or maybe a system diagram or a construction method. To tune these tests, it is important to develop an understanding between the worlds of theory, design, construction and regulations. As project progresses, each test becomes more sophisticated with computer modelling, research, prototyping and so on, until it can pass any test we can throw at it. Engineers now use the latest design technology in analysis, visualisation, digital manufacturing, research and planning. In the end, for engineering design in harmony with the physical world and with nature, only the fittest ideas survive.

This process happens continuously and is not readily subject to order; at the same time in the interests of getting horses before carts it is beneficial to have the design concept in place before too much effort is given to the details and consequently ideas must also pass a test of timeliness, and a test of resource. This is called project management, and uses such things as Gant charts and the business case.

Attendance, tests, crits and assessment

Attendance is not compulsory but, as this is a practice based activity, if you do not attend regularly you will almost certainly fail the course.

The course has no summer exams and no homework. Instead assessment is based on:

1) Impromptu tests to find out the degree of understanding and experience students have developed. No special preparation is needed for these tests. These earn the majority of marks for the course. Students receive individual marks for these tests.

2) A number of marked criticism (“crit”) sessions, which are assessed at the end and immediately after the class with marks being awarded on a group basis. Again no special preparation is needed for these tests.

In imitation of the real world, no notice will be given for either the tests or the marked “crits”. Also because the class is run in real-time workshops, it is not possible for students who miss a class or a significant part of a class to be given an opportunity to retake. Any marks lost in a missed class will be forfeit.

Equipment and sketchbook

Students will need appropriate design sketching equipment, such as sketchbooks, sketching pencils, thick and thin felt-tip pens, and yellow “butter” paper. These are on sale as a pack within the Department at less than commercial rates. Students are also encouraged to develop an understanding of precedent and the “possible” through the habit of engineering observation. This can be done by visiting, sketching or photographing both engineering and non-engineering subjects in everyday life and keeping these in an engineering sketchbook for future reference.

Relationship to the overall 3 year design syllabus

Design, theory, construction and projects are inextricably linked. So Creative Design 1 and 2 form a two year foundation course with the essential skills of engineering and design at its heart. The module is practical, and workshop based. The aim is for students to get lots of experience of design through what we call “patient practice”. It is analogous to learning to play a musical instrument, at first it is difficult but eventually you can improvise.

The essential quality of an engineering design is that it works and this is what the course concentrates on. The word “creative” has a special meaning in engineering, involving problem solving, synthesis and ingenuity. Wackiness is rarely a virtue. So after a short introduction to basic creative design tools such as sketching and communication skills, Creative Design (1) tackles engineering design entirely in the context of projects. Help will be given in the writing and interpretation of a project brief, in brainstorming engineering solutions, in assessing them, in making creative design choices, in recognising a good engineering design “diagram”, and in developing an engineering idea so that it is practical, provable and affordable and hopefully elegant. From the very first session, students will be invited to practice these themes through the design variations of apparently simple objects, such as a chair or a house. Year 1 culminates with students modelling one of their designs, and testing it.

Creative Design (1) and (2) lead to a Group Design Project in the third year, (CE315). In this, student groups work full-time in studios over a four week period, and spend one week managing and building a group construction project on site. These projects provide an opportunity for students to show their grasp of the CD 1 and CD2

foundation course skills, and to link them together in a significant piece of engineering project work.

Non-curriculum learning, and link to 3rd Year Group Design Project CE315

It is important to go through the engineering course, and the world outside, with your eyes and ears open.

Students are given notice here that in the 3rd year they will participate in the Group Design project CE 315 which counts for a significant proportion of the 3rd year mark. CE 315 includes a number of extra-curricular learning requirements which students need to recognise at the start of the 1st year. The benefit will be felt during all parts of the design and construction courses and in the rest of the M.Eng curriculum studies.

In particular, students should be aware that the design courses require a knowledge of many things that are not specifically part of the M.Eng curriculum, but which are nevertheless an essential part of an engineer's life. These include a basic knowledge of construction methods and tools, project planning, cost management, site health and safety, and risk assessments, as well as design and applied theory. The 3rd year design projects also require a working knowledge of the planning process, the environmental assessment process, and the preparation of a business case which ensures that the basis for a project is sound.

CD1 and CD2 and the Yr 3 projects are also greatly helped if students interest themselves from the start of their time at Imperial in what goes on in the built environment, and in particular in engineering precedent in the form of built projects. It is no coincidence that many of the most successful design students have vacation work experience in engineering design or construction companies, read engineering and architectural magazines, and visit finished projects and construction sites whenever they can.

The design projects are also helped if students familiarise themselves with EXCEL, Autocad, Rhino/Solidworks, and the Oasys suite of engineering software especially GSA.

Feedback

Students who want constructive feedback on their performance are invited to stay behind at the end of the class for a discussion with Chris and Ed. Unfortunately given the constraints of numbers and the workshop format there will be no other regular formal opportunity to discuss work.

Chris and Ed welcome suggestions to change the course at any time, and will do their best to take valid concerns on board. These suggestions can be emailed, or discussed in person after (but not during) the class.

Module co-ordinators

Chris Wise and Ed McCann work interactively with students in the workshops, and are responsible for assessment.

[Chris Wise](#) is a practising structural engineer who spent nearly 20 years with the international consulting firm of Ove Arup and Partners. At Arup he was appointed their youngest Director, and was one of 5 Board members (with particular responsibility for design matters) in charge of 600 building engineering staff. Among other things he has been responsible for the engineering design of Europe's tallest building and the world's first green high-rise (Commerzbank HQ, Frankfurt),

London's Millennium Bridge, the Stirling Prize winning American Air Museum at Duxford, the Barcelona Communications Tower and Channel 4's HQ.

In 1999 he left Arup to found the engineering design practice Expedition.

He was appointed Royal Designer for Industry by the Royal Society of Arts, only the second structural engineer to be honoured in this way, and one of only 90 RDI's in the country from all creative design disciplines. He has been elected a Fellow of the Royal Academy of Engineering, and an Honorary Fellow of the Royal Institute of British Architects. He has appeared on many tv programmes including as co-presenter of BBC2's Building the Impossible in 2002. At Imperial he can be contacted generally on Fridays.

[Ed McCann](#) is a civil engineering graduate of Imperial College. He worked for Binnie, Black & Veatch for 12 years and joined Expedition Engineering as an Associate Director in 2002. At Binnies, Ed worked on over fifty civil engineering projects in more than ten countries. The main areas in which he has worked are: river & estuarine engineering, coastal protection, water supply as well as storm-water and foul drainage. In 1999 he was appointed Water Engineering Team Leader for the Terminal 5 (T5) Project at Heathrow, where he led a group of over 20 engineers and technicians within an integrated team of over 500. He was directly responsible for the design of infrastructure with a construction value in excess of £50M.

Since joining Expedition he has worked on projects including the competition-winning Stockton footbridge, Barcelona Bull Ring, Granite Wharf residential towers at Greenwich, and an innovative drainage system for an all weather race track at Kempton Park. He is an experienced design team leader and is currently Project Director on the Stockton Footbridge where he is responsible for marshalling the efforts of all of the structural and civil engineers, architects, lighting consultants and so on. Ed has extensive experience leading the design on complex multi-disciplinary projects where the support of third parties is essential.

He has a particular interest in the environmental performance of projects and received on behalf of his team the BAA/CIRIA 2000 Environmental Construction Award for "Environmentally Responsible Design" for the design of the water supply system on the T5 project.

Between 1992 and 1994 Ed lived in Mexico whilst completing a Masters degree in Hydraulic Engineering, as a result of which he speaks fluent Spanish. Recently, Ed co-presented the Channel 4 series "Men of Iron" about Isambard Kingdom Brunel, and is presenter of "No Problem", a 5 part tv series for Channel 4 Schools.

(If this isn't enough you can find out more about their engineering design consultancy at www.expedition-engineering.com)

Recommended Reading

LS BLAKE, Civil Engineer's Reference Book

ROY CHUDLEY, Construction Technology

BS 6100: Building and Civil Engineering Terms

For current developments in creative design thinking in the built environment, it is worth browsing through design periodicals such as the New Civil Engineer, RSA magazine, Blueprint, the IABSE Journal and the Architects' Journal.