



Professor Dame Ann Dowling: the first year at the helm

I inherited an Engineering Department in great shape, thanks to Professor Keith Glover, when I stepped up to become its Head in October 2009.



Professor Dame Ann Dowling with India's leading industrialist Mr Ratan Tata, Chairman of the Tata Group who visited Cambridge in June 2010

Growth has been impressive, the awards both prestigious and numerous, and the league tables consistently show that we are the number one engineering department in Europe and among the leaders in the world. But there is no room for complacency. Cuts in government expenditure are on the way and we will have to fight hard to keep our place amid stiff international competition. Among the priorities are the needs to keep attracting the best students, secure more philanthropic donations and build even stronger links with our business partners.

At a time when there is concern about the number of UK school leavers choosing to study science and engineering, it is exciting to report that our undergraduate student applications have increased by 40% over the last five years and by 16.5% in the last year alone. We had a record intake in October. Our schools outreach programme, good course design and high quality teaching have all helped us to achieve these results.

A highlight of the year was undoubtedly the opening by the Duke of Edinburgh of the Alan Reece Building which now provides a congenial working environment for our Manufacturing and Management Division.

The generosity of Dr Alan Reece, the Gatsby Charitable Foundation and the Government's Scientific Research Infrastructure Fund made this building possible. A bequest from Dr Denis Armstrong of GBP 1.7 million to finance research students in the crucial work of linking engineering research to medical clinical need (see page 23) will also have a hugely positive impact on all of our lives.

The generosity of Laing O'Rourke has been a particular excitement of the last year with GBP 10 million of new funding for a Professorship, two Lecturers and a new Masters course to lead a revolution in education and research for the construction sector. This initiative will be complemented by a new GBP 6 million EPSRC Innovation and Knowledge Centre (IKC) focussed on Smart Infrastructure and Construction. This will combine business knowledge with the most up-to-date research to harness the full potential of emerging technologies. The breadth and depth of industrial commitment to these projects are impressive and mark a new high point in the Department's continuing efforts to connect with industry and address its challenges with the highest quality teaching and research.

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An integrated engineering department founded on core strengths spanning all engineering disciplines and also cross-connected by three strategic themes:

- Cognitive Systems Engineering
- Engineering for Life Sciences
- Sustainable Development.

www.eng.cam.ac.uk

The remarkable accuracy of the Trinity College Clock

The pendulum clock in Trinity College, Cambridge was installed in 1910. It is remarkably accurate, known to be better than one second per month, but it was only in 2009 that a system was finally introduced to monitor this tiny drift.



The work was done as part of a 4th year MEng project here at the Department of Engineering. A sensor on the pendulum detects the going of the clock, which is compared to the accurate time signal from a GPS receiver. Dr Hugh Hunt is the Keeper of the Clock.

The Trinity Clock in Great Court is a prominent feature of the college. It has a curious way of announcing the hours, once for Trinity and a second time for St John's. It is always within a second or two of the correct time and yet it hardly ever requires adjustment. Does this mean that the mechanism is unaffected by the elements? What about temperature, pressure, humidity? And does the gravitational pull of the moon make any difference? The pendulum on the Trinity Clock has been instrumented to measure period and amplitude to great accuracy. The time is compared with UTC obtained from a GPS receiver. All of this data is streamed continuously to the web at www.trin.cam.ac.uk/clock/. If you thought that the physics of a pendulum was simple, then think again!

Athina Markaki has been awarded a €1.5 million grant from the European Research Council (ERC)

Athina Markaki from the Mechanics, Materials and Design Division has been awarded a €1.5 million grant from the European Research Council (ERC) to set up a 5-year research group under the ERC's 'Starting Independent Researcher Grant' programme.

Athina's project aims to improve the life span of prosthetic implants such as hip replacements. Bone is an active material, it responds to stresses and strains. In the absence of straining (this is also known as "stress shielding"), bone adjacent to implants can become unhealthy, contributing to loss of adhesion. (Orthopaedic implant loosening has two main causes – poor bonding and "stress shielding".) For implants to be successful and to last for a decent length of time, it is recommended that the patient should follow physical exercise regimes. In cases where the patient is completely immobile or with very restricted mobility, this is not possible. In these cases, drugs are often administered which can have side effects. Athina and her team are working on a therapy whereby controlled levels of mechanical strain could be induced directly in growing bone via the prosthesis itself.

The idea proposed in Athina's project is that the implant should have a highly porous surface layer, made by bonding ferromagnetic fibres together, into which bone tissue growth would occur. During the post-operative period, application of a magnetic field will cause the fibre network to deform elastically, as individual fibres tend to align with the field. This will impose strains on the bone tissue as it grows into the fibre network. Such mechanical deformation is known to be highly beneficial in promoting bone growth, providing the associated strain lies in a certain range (~0.1%). Preliminary work, involving both model development and experimental studies on the effect of magnetic fields on fibre networks, has suggested that beneficial therapeutic effects can be induced using field strengths no greater than those already employed for diagnostic purposes.

"Naturally, I was very happy to hear that my proposal had been accepted", Athina says. "The EU funding will enable me to build a group of students and post-docs to share in this exciting project. I certainly enjoy this type of research immensely and I would



like to do this while carrying out research of real potential benefit for society." The project will be carried out in close collaboration with the Orthopaedic Research Unit (ORU), Department of Surgery, University of Cambridge.

The ERC encourages researchers to take risks in their research and go beyond established frontiers of knowledge and the boundaries of disciplines. The Starting Independent Research Grant scheme targets promising researchers in Europe who have the proven potential of becoming independent research leaders. The grant can mount up to two million Euros for setting up a research group and all further costs related to conducting a pioneering research project.

For further information please contact Dr Markaki, email: am253@cam.ac.uk

Research Horizons, the University of Cambridge research magazine, features Athina's project on its website: www.research-horizons.cam.ac.uk

News from the Centre for Advanced Photonics and Electronics

Dr Daping Chu is the new Head of the Photonics and Sensors Group and Chairman of the Centre for Advanced Photonics and Electronics (CAPE) Steering Committee.

The former role is to lead the existing research work in the group, in particular to organise the display-related activities, and to start new research directions. The latter role is to support the CAPE Director in CAPE-related activities and manage the day-to-day running of the CAPE Office. Our thanks go to Professor Bill Crossland who has recently stepped down from both of these positions. During his five years in post he has taken CAPE from strength to strength and the article referred to below, highlights what has been achieved in this time.

An article entitled 'CAPEable collaboration' was recently published on 'New Electronics', the website for electronic design engineers. Graham Pitcher, the editor, who wrote the article discusses how University/industry collaboration is enabling leading edge research at the Centre for Advanced Photonics and Electronics.

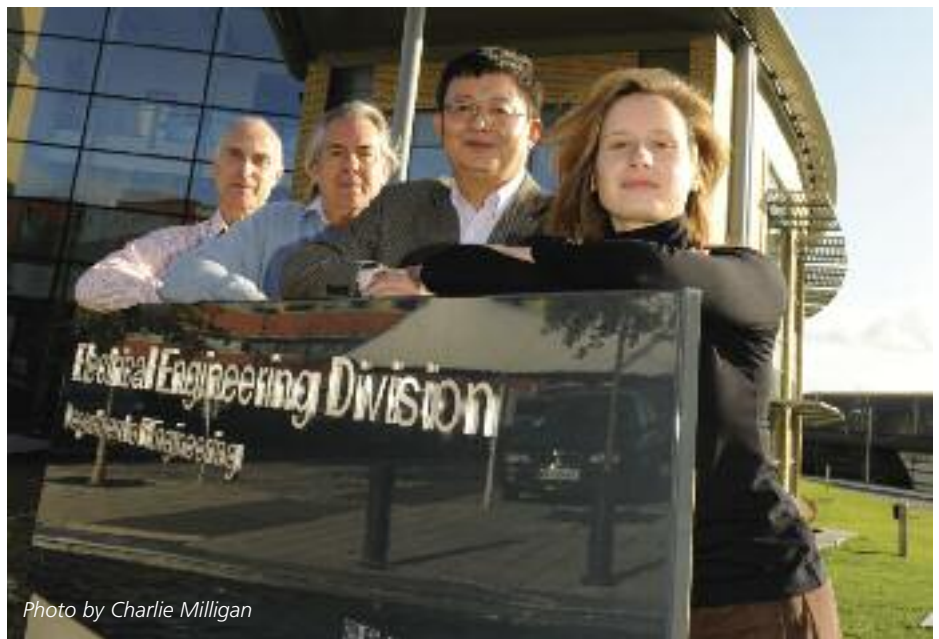


Photo by Charlie Milligan

"If there is one area of science where industry and academia should come together, it is surely electronic engineering. The potential commercial applications of electronic developments are so huge that you might believe innovative work in academia would be feeding continually into the commercial world."

Follow the link to read the article:
www.newelectronics.co.uk/article/20856/Cover-story-CAPEable-collaboration.aspx

The article can be downloaded as a PDF at: www.eng.cam.ac.uk/news/stories/2010/CAPEable_collaboration/newelectronics_article.pdf

Dr Andrea Ferrari receives a Royal Society-Wolfson Research Merit Award

The Royal Society, the UK's national academy of science, has recognised the work of Dr Andrea Ferrari at the Department of Engineering with one of the prestigious Royal Society Wolfson Research Merit Awards.

The award is given to individuals of proven outstanding ability to undertake independent, original research. Andrea outlines his research as follows. Fundamental science plays a crucial role in underpinning and generating future technologies. The ability to manipulate the structure and composition at the nanoscale opens new horizons and opportunities to create novel materials with superior performance. The introduction of new, low-cost materials, encompassing polymers, advanced liquid crystals, and nanostructures, will have a disruptive impact on a variety of devices based on conventional inorganic semiconductors, not only because of cost/performance, but also because they can be manufactured in more flexible ways,

suitable for a growing range of applications. Carbon is one of the most versatile elements in the periodic table, forming allotropes with diverse properties. Rolled-up individual graphite sheets (graphene) may form hollow cylinders known as carbon nanotubes. They exhibit promising electrical, optical, thermal and mechanical properties. Graphene also has remarkable electronic and optical properties that qualify it for applications in future optoelectronic devices, including solar cells. Semiconductor nanowires are a class of low dimensional objects in which carrier motion is restricted in one direction. Due to quantum confinement, they have discrete energy spectra that are strongly size dependent.

Andrea's research group aims to

overcome some of the challenges for utilization of graphene, nanotubes and nanowires for large area optoelectronics, and produce a variety of devices ranging from ultrafast lasers, broadband photodetectors, solar cells, touch screens, smart windows and displays, exploiting the unique properties of these nanomaterials.

Further information can be found on the Nanomaterials and Spectroscopy Group webpages at www-eng.cam.ac.uk/nms/home.html

More information on the award and the other winners can be found on the Royal Society's website at: <http://royalsociety.org/>

Professor Steve Young receives prestigious awards



It has been announced that Professor Steve Young is to be awarded the International Speech Communication Association (ISCA) Medal for Scientific Achievement, the most prestigious ISCA award which is given to the most distinguished researchers in the field of Spoken Language Processing. Professor Young is well known for major contributions to the theory and practice of speech recognition systems, along with his more recent work on applying statistical modelling approaches to spoken dialogue systems. The ISCA medal will be presented at the Interspeech 2010 conference in Makuhari, Japan at which Professor Young will give the opening Keynote Address.

The Institute of Electrical and Electronics Engineers (IEEE) announced that Professor Young has received IEEE Fellow status – the highest category of IEEE membership – “for contributions to speech processing, speech recognition and spoken dialogue systems”. He also received a prestigious Technical Achievement Award from the IEEE Signal Processing Society in 2004.

Professor Young has recently taken up the role of Pro-Vice-Chancellor for Planning and Resources in the University, but still maintains an active research group.

For more information about Professor Young's research, his achievements and research group, please visit the following web-pages:
<http://mi.eng.cam.ac.uk/~sjy>

www.neuroscience.cam.ac.uk/directory/profile.php?sjyoung

Adoption of energy efficiency innovations in new UK housing

Dr Dick Fenner (Centre for Sustainable Development) and a former Engineering for Sustainable Development MPhil student, Joan Ko (now working for Arup), have been awarded the James Watt Medal for 2009 by the Papers Panel of the Institution of Civil Engineers (ICE). This is for their paper entitled "Adoption of energy efficiency innovations in new UK housing" which was recently published in the Institution Proceedings Energy Journal.



The paper responds to the Government's target to provide three million more homes in England by 2020 by examining why developers do not adopt energy efficiency measures more widely. The housing sector is responsible for over a quarter of the nation's total carbon emissions and new targets require all new homes to be zero carbon by 2016. Yet change in the house building industry has been slow and building regulations in England and Wales lag behind energy standards in other European countries. The paper considers the house building industry as a complex socio-technical system made up of many actors who both work together whilst sometimes constraining each other's actions. Through interviews with commercial developers, local and central government bodies, architectural consultancies and housing associations, barriers relating to these actors' willingness, motivation and capacity for change in introducing energy-efficient measures into new build housing were identified. A series of policy responses were proposed to overcome these barriers and these help suggest strategies to drive improved energy performance in UK new build homes. In order to provide a real context to explore the implications of these recommendations, the paper considered how such responses may be integrated into a sustainable new

(eco)town development. It concluded that to stimulate innovation, all parts of the socio-technical system need to be influenced by all the mechanisms available to the UK government.

The James Watt Medal is awarded for papers having a substantial mechanical engineering content. The medal, named after James Watt, the Scottish mechanical engineer and inventor who died in 1819, was introduced by Robert Stephenson (President of ICE in 1855-1856) who recommended Council to acquire the dies of the medal from Joseph S Wyon in 1858. This medal is awarded annually currently for the best paper in the Institution Proceedings on energy. The award will be presented to Dick and Joan by the current ICE President, Jean Venables, at the annual ICE awards ceremony.

Ko J., Fenner R.A. (2007) Adoption of energy efficient innovations in new UK housing. Proceedings of the Institution of Civil Engineers, Energy Journal 160, Issue EN4 (November 2007) pp 151-163

An abstract of the paper can be found on the Institution of Civil Engineers website at:
www.icevirtuallibrary.com/content/article/10.1680/ener.2007.160.4.151

Earthquake research reaches across Europe

Real-time transnational access will enable researchers to participate in experiments all over Europe without leaving the lab.



Centrifuge at the Schofield Centre.
Photography by Howard Guest

In an underground chamber at the Department's Schofield Centre lies the UK's largest centrifuge and the world's most productive machine for observing and measuring geotechnical phenomena. The Turner centrifuge travels at speeds of 200 miles per hour and creates 150 times the earth's gravity. The 10 metre diameter centrifuge is being used to model loads and pressures experienced during earthquakes, and to simulate tunnels and wind farms.

Now, thanks to funding from the European Commission (EC), experiments carried out in Cambridge will soon be 'talking' to experiments happening at the same time at sites across Europe. Data will be fed in real-time across the internet to other sites participating in the project, allowing multiple institutions to take part in a common experiment. In all, 23 institutions, each with its own specialist equipment, are involved in research aimed at answering questions about the behaviour of shallow building foundations in earthquakes.

The Seismic Engineering Research Infrastructures for European Synergies (SERIES) project is being coordinated by Dr Gopal Madabhushi and Dr Stuart Haigh. "European seismic engineering research has tended to suffer from extreme fragmentation of research infrastructures and limited access to equipment between countries," explained Dr Madabhushi.

"SERIES answers this need by enabling the key actors in Europe's seismic engineering research, including three industrial beneficiaries, to coordinate remote research activities in real-time."

The project builds on the success of a smaller-scale initiative between the UK's three leading earthquake engineering laboratories at the Universities of Cambridge, Oxford and Bristol with funding from the Engineering and Physical Sciences Research Council (EPSRC). This showed the benefits of creating real-time, grid-based communications to provide access to experimental facilities and data.

For SERIES, the efficiency and cost-effectiveness of resource usage is considerable: it's been estimated that the annual cost to the EC of the four-year programme is less than 1.35% of the total present value (€190 million) of the material resources to be shared by the 23 participants.

For more information, please contact Dr Gopal Madabhushi (mosp1@eng.cam.ac.uk) or visit the SERIES website (www.series.upatras.gr)

**This article is reproduced from Research Horizons, the University of Cambridge research magazine
www.research-horizons.cam.ac.uk**

Professor Mair awarded CBE in the Queen's New Year's Honours List

Professor Robert James Mair, FEng FRS has been recognised in the Queen's New Year's Honours list.



Professor Mair, Master of Jesus College and Professor of Geotechnical Engineering, has been made a CBE for services to engineering. His research focuses on Underground Construction, Urban Infrastructure Renewal and Innovative Sensor Technologies for Infrastructure Monitoring.

He has advised on numerous projects world-wide involving soft ground tunnelling, retaining structures, deep excavations and foundations. Recent international projects have included railway tunnels in the cities of Amsterdam, Barcelona, Bologna, Florence, Rome and Warsaw, and motorway tunnels in Turkey. In the UK he has been closely involved with the design and construction of the Jubilee Line Extension for London Underground, and with the Channel Tunnel Rail Link and Crossrail projects. He was responsible for the introduction of compensation grouting in the UK as a novel technique for controlling settlement of structures during tunnel construction – on the Waterloo Escalator Tunnel Project. The technique was widely used on the Jubilee Line Extension Project for the protection of many historic buildings, including the Big Ben Clock Tower at the Palace of Westminster.

Get a grip

Professional Engineering magazine published an article on inclusive design and featured the work of the Department's Engineering Design Centre (EDC). The publishers have kindly granted permission for the article by Lee Hibbert to be reproduced below.



Freestyle 700 handset

Inclusive design means making products that can be used by everyone, even those with arthritic fingers or poor vision.

Opening a carton of orange juice is so much fun these days, isn't it? I'm sure everyone really enjoys squeezing their finger into a tiny loop of plastic, before having to pull back vigorously, virtually garrotting the tip.

While this cumbersome packaging might only be a mild source of irritation to some of us, it is indicative of a far more serious problem affecting the elderly and infirm – that too many products simply aren't designed "inclusively," and fail to take account of our ageing population. From jar tops that would test the iron grip of the world's strongest man, to touch-screen mobile phones that can only be operated by the nimblest of fingers, there is a seemingly endless list of consumer products that appear to have been deliberately designed to prevent many people from using them.

According to Peter Gore, Professor of Practice (ageing and vitality) at Newcastle University, this is something that provokes extreme frustration among older people. "We still don't have a culture of thinking about designing products to include the elderly, and that's surprising really when you consider the change in demographics that has been seen in recent years," he says. "Most companies are aware that we

have an ageing population but, when it comes to the way their products are designed, the penny doesn't seem to have dropped. They fail to realise the effects of ageing and don't even appreciate that the expectations of older people have changed dramatically. Many older people are still very fit and active but just need a bit of help to enable them to manage a decline in their functional capabilities."

And Gore believes that a failure to consider inclusive design also represents a significant missed business opportunity. "Around 80% of disposable income is in the hands of the over-fifties," he says. "Yet many companies seem obsessed with targeting young people who, as a group, don't have anywhere near as much money to spend. Older people want functional products that look good. They don't want products that stigmatise them."

Inclusive design doesn't mean designing for old people – it means designing mainstream products and services so that they can be used by as many people as practicably possible. It is a pragmatic way of broadening the potential market. The predominant issue is helping people with age-related multiple minor impairment of cognitive, physical and sensory abilities. Inclusive design is not about creating specialised products or services for older people, although these are often important and complementary in their own way.

Shower of approval

The bathroom industry has made significant efforts to meet the needs of older people. Triton Showers has worked with RNIB Access Consultancy Services to produce an inclusively-designed shower product for the care market. The product (pictured) was the first to be awarded the new RNIB Reference approval, which recognises accessible and inclusive design in mainstream products.

RNIB's process included a consultation with Triton's designers, a full product assessment phase, and extensive user testing.

Improvements were made to the operating instructions, finish and colour contrast, font size and text design, tactile and audible feedback, and a new shower head lever design.

The shower is now deemed very easy to use by all. The strong colour contrast helps people with sight loss to identify the controls and temperature settings. The controls are easy to operate by people with reduced strength or manual dexterity.

Gore says it is fine for some companies to target their products at the younger market – as long as this represents a strategic business decision. But he says that all too often firms jettison other market sectors, not because they have consciously decided to do so, but because their design processes are ill-conceived and, as a result, their products inadvertently exclude people.

However, some companies have taken these issues on board and have got the inclusive design process down to a tee. A particularly good example of this is the Good Grips range of kitchen implements by Oxo, founded in 1990 by Sam Farber on the principle of universal design. After witnessing his wife struggle using everyday kitchen utensils due to a mild case of arthritis, he was inspired to develop a range of tools that were easy to use for the largest spectrum of people. An inclusive design process was then undertaken which resulted in a hugely successful range of ergonomically designed, trans-generational tools that set a new standard for the industry and raised the bar of consumer expectation for comfort and performance. The range now contains more than 900 products covering many areas of the home. These include kitchen utensils featuring Oxo's trademark soft grip handle that's non-slip even when wet.



"The Oxo grips are an excellent example of inclusive design," says Gore. "They weren't designed for people with arthritis – they were designed for everyone. And this impacted profit, because it meant they could be sold into a much bigger market than they might have been."

"There's no doubt that we are still at the innovator/early adopter stage of the inclusive design market and there remains exciting market potential. But the majority of companies haven't got there yet. There are still not many products available. That's because big organisations are conservative and step-changes such as this create fear." So how do companies go about embedding inclusive design into their product creation processes? How can it be so firmly instilled within people's thinking that understanding and responding to diversity within the population becomes a natural way of operating?

Those are questions that have been pondered by some sharp minds within the Engineering Design Centre at the University of Cambridge, which has spent several years developing an online, free-to-use inclusive design toolkit. The resource is aimed at helping companies to get a better understanding of customer diversity, and how they can build these considerations into the design of mainstream products better to satisfy the needs of more people. The toolkit is layered so that there are a series of steps that can get companies started and deliver tangible benefits, which can then be progressed to greater depth.

"It is one thing convincing people of the need to adopt inclusive design, but actually doing something about it is something else," says Ian Hosking, senior research associate at the Engineering Design Centre. "The toolkit is really there for people who understand the case for inclusive design and want to do something about it."

Essentially, there are three key stages where inclusive design needs to be considered during the product development process – during the exploration, creation and evaluation phases. The toolkit puts in place a robust problem-solving process to help companies achieve this. Hosking says that, typically, companies fail to identify the fundamental need that they are trying to address during the exploration phase of product development, and this leads them to jump ill-prepared into coming up with a solution. "Often that need is not clear – research shows that if you ask people what they want there is often a big difference between what they say that they want and what they actually need," says Hosking. "People are often quite poor at articulating what the underlying needs are, and as a result there's often a superficiality of understanding."

It's good to talk... especially when you can hear the person at the other end properly

Telecoms giant BT has worked with the Engineering Design Centre at the University of Cambridge and is committed to the use of inclusive design principles throughout its product design processes.

The first product produced using the inclusive design toolkit was the Freestyle 700 handset (pictured). Initial concepts, along with consumer consultation, came up with criteria for the phone, which formed the basis of what it looked like and how it operated. BT used inclusive design techniques to ensure that the phone was easy to dial, with large comfortable keys, and easy to read, with high contrast and large characters. Thought was given to ease of hearing, with a comfortable ear bowl, volume adjustment and inductive coupler for digital hearing aids, and a lower frequency ringer was adopted to make it easier to hear. The phone has no icons and no abbreviations, and has keys with single functionality. There are also large, separate keys to start and end calls.

Since its launch in July 2008, sales of the Freestyle 700 have surpassed expectations. The inclusive design has also minimised product returns, thereby improving profitability, despite higher manufacturing costs.

During the creation phase, other problems can arise. He says that often companies "fixate" on one solution, usually one that offers the path of least resistance. The toolkit helps firms to employ techniques that broaden out creativity so that a greater number of inclusively designed solutions are considered.

And, at the evaluation stage, Hosking says that firms frequently get so close to the new design that they have been working on that they can easily lose objectivity. "So, evaluation is critical in bringing objectivity," he says. "It's about coming up with the right level of rigour without becoming bureaucratic and cumbersome."

The toolkit is undergoing further refinement and enhancement, and a new version of the software is available at www.inclusivedesigntoolkit.com. The Cambridge Engineering Design Centre is also involved in industrial projects, with telecommunications companies particularly interested in adopting inclusive design principles.

"Touch screens on mobile phones offer a lot of opportunity because they are highly configurable but there are challenges about a lack of familiarity and inherent structure, particularly for older people," says Hosking. "The mobile phone industry is a fast-moving target – so we have to keep understanding what the needs are for the older population as its products and services evolve. That's something that we are proactively looking at."

For more information contact: Ian Hosking, Senior Research Associate at the Engineering Design Centre, Email: imh29@eng.cam.ac.uk

First European Inclusive Design for Competitive Advantage Consortium

Representatives from companies as diverse as Nestlé, Marks & Spencer and the BBC will embark on a series of meetings, workshops and informal project development sessions introducing them to the latest thinking and research in the field of Inclusive Design.

The consortium has been set up by the UK-based Centre for Business Innovation (CfBI), in collaboration with the Engineering Design Centre. Each company will have its own ideas about how to adopt inclusive design principles, but by working together, and with support, they will be able to apply the Engineering Design Centre's world-leading research to their own businesses in ways that might not have emerged outside the consortium format.

The Engineering Design Centre inclusive design webpages can be found at: www-edc.eng.cam.ac.uk/research/inclusivedesign/

Clean engines on the front burner

The Engineer magazine Technology and Innovation Awards returned to The Royal Society to celebrate the 2009 most successful UK engineering projects.



From left to right: Dr Matthew Juniper, Mike Hield and Robert Llewellyn

The event, sponsored by BAE Systems and hosted by Scrapheap Challenge and Red Dwarf star, Robert Llewellyn, saw winners in seven categories receive awards for ground-breaking technologies as a result of collaboration between universities and industry.

The award for Environmental Technology was received by the Department's Dr Matthew Juniper and Rolls-Royce, who have jointly developed a software tool that can help in the design of cleaner jet engines.

The article on InstaFlow below, appeared in a special awards edition of The Engineer magazine.

Researchers have joined forces in an attempt to work out how jet engines can be operated using more air and less fuel. Jet engines are a simple concept but a complex reality. Sometimes described as 'a bucket that you burn fuel in', their precisely machined components and painstakingly chosen materials are designed to eke as much of the energy embodied in the fuel into the force that propels aircraft through the air.

Making these engines as environmentally friendly as possible is also a complicated matter. As well as carbon dioxide, jet engines can produce poisonous oxides of nitrogen (NO_x) under certain conditions. Understanding the complex interplays of gas flows, combustion and temperature that give rise to these conditions – and then finding out how to avoid them – is a daunting prospect, which Matthew Juniper of Cambridge University took on with the assistance of Rolls-Royce.

'If you want to operate cleaner, with low NO_x production, you need to burn with lots of air and less fuel,' he said. 'Having lots of air keeps the temperature down in the combustion chamber and it's high temperatures that give rise to the

NO_x; essentially, you start burning the nitrogen in the air. So you want to burn colder, but of course the colder it is, the harder it is to keep a flame going.'

To make sure their engine is burning lean and not producing NO_x, engine designers must ensure that the fuel and air are mixed as well as possible. Otherwise, the regions that are richer in fuel will burn hotter and the resulting high temperature will lead to NO_x generation. However, the small ratio of fuel to air causes other problems. The conditions put the flame on the very edge of instability. 'Everyone who cooks with gas burners has seen this effect,' said Juniper. 'If your pan boils over and blocks up half the holes, the other holes start to burn much faster and then, as the blocked holes clear, you get an oscillating effect across the burner as the flames grow and shrink until they settle back down.'

'In a jet engine combustion chamber, you get pressure waves that can interact with the flame in the same sort of way,' he added. 'The flame comes from the fuel injector into the combustion chamber and a pressure wave hits it and perturbs it. A little later, the flame will give out a bit

more heat, which will increase NO_x generation. If you're unlucky, the heat release comes at just the wrong moment and adds to the oscillation, and that can lock into the resonances of the combustion chamber. That's much more likely to happen in lean flames than rich ones.'

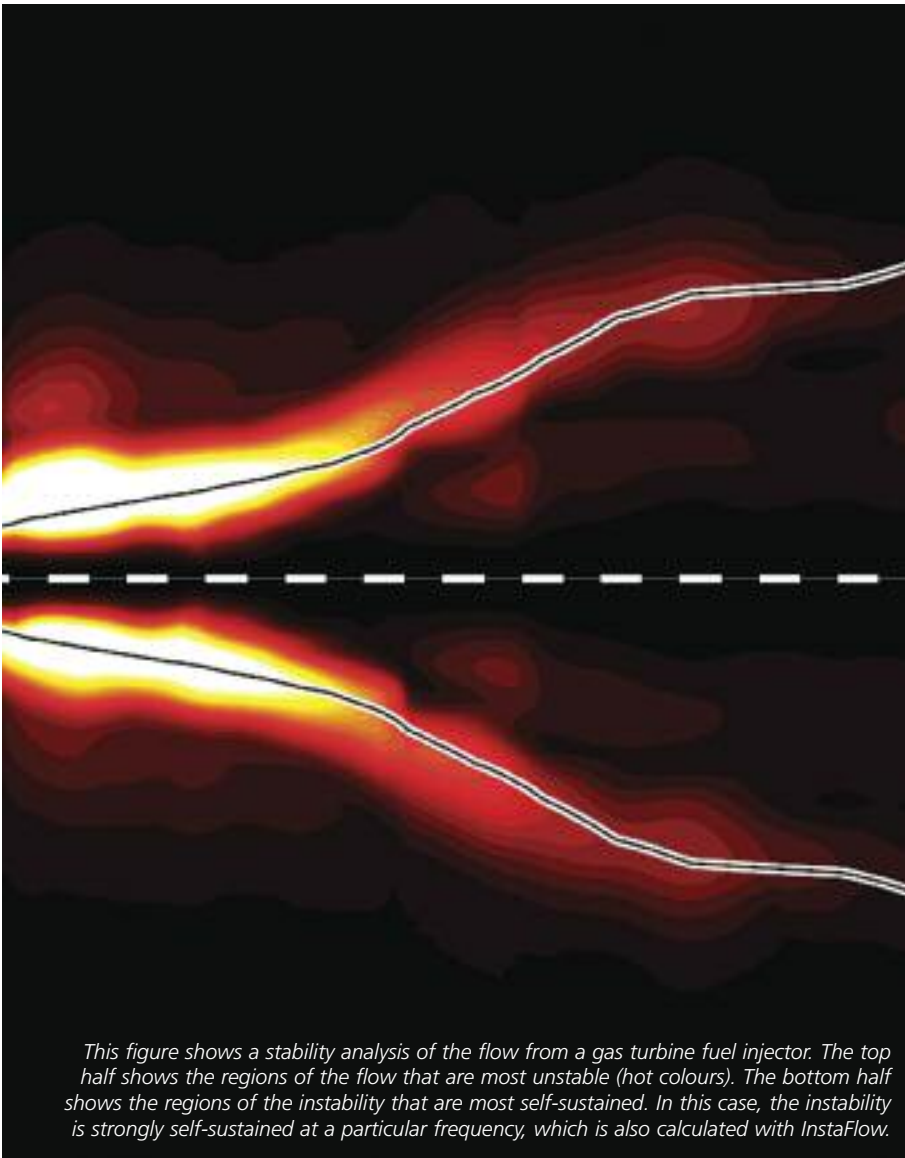
What is needed is some way of understanding how the design of fuel injectors and the geometry of the combustion chamber interact to form this sort of instability, but the complexities of the fluid flows make this extremely difficult. However, Juniper's team has used some recent advances in applied mathematics to develop some software that could solve this problem.

The system, called InstaFlow, generates simulations that work in a similar way to MRI. 'We take a slice through the injector and the system tells you which bits of the injector are responsible for good mixing and instabilities,' he said. 'Then, crucially, it tells you what frequency and shape the motion will be - will the gas jet flap backwards and forwards or side to side? With that information on one injector, you can look at how it will fit into the acoustic modes – the pressure waves – in the combustion chamber.'

This, said Juniper, is a tough problem. The research team is using applied mathematics first published 10-15 years ago, which is an unusually short time for maths to be applied to practical engineering. 'Applied mathematicians tend to lose interest once the basic problem has been solved,' he said. 'The processes behind this tool had been applied to a flow behind a cylinder, which is a standard problem in applied maths, but it hadn't been applied to anything much more complex than that. I don't think anyone quite believed we would get this to work.'

Cambridge University's engineering department has close links with Rolls-Royce and the company began to sponsor the project in 2005, two years after Juniper started working on InstaFlow. 'We had a PhD student working on the maths, which was the side we really had to nail. Then I worked with another PhD student with Rolls-Royce this year, where we sat with the company's design team and worked out what it wanted to feed into this thing and what it would like to get out.'

The current version of InstaFlow accepts the outputs from Rolls-Royce's computational fluid dynamics (CFD) system. The output, which is generated in a few hours, is graphical – a slice through



This figure shows a stability analysis of the flow from a gas turbine fuel injector. The top half shows the regions of the flow that are most unstable (hot colours). The bottom half shows the regions of the instability that are most self-sustained. In this case, the instability is strongly self-sustained at a particular frequency, which is also calculated with InstaFlow.

the injector highlighting the position and shape of instabilities. 'It's almost at the stage where you press a button and just let it run,' said Juniper.

The InstaFlow code was written in a modular form using Matlab software. Juniper's team is currently trying to speed it up by removing modules, reprogramming them in the more streamlined C++ language and plugging them back in. 'The speed is so important to the design process,' he said. 'Who wants to wait a week?'

The team is also developing plug-in modules, such as FlowTweak, which shows the effects of changing the flow profile. 'You'll have a flow profile from CFD and that gives rise to a certain instability,' explained Juniper. 'If you want to make that flow a bit quicker through the centre of the injector, you can drag a line with a couple of mouse clicks and it will recalculate to see what that does to the instability.'

The next phase of the project is to validate the data produced by InstaFlow against systems that have already been

fully examined. The flow profiles in fuel injectors for jets are very similar to those encountered in papermaking equipment, and Juniper has been testing InstaFlow against the analysis from these systems. 'A Swedish papermaking firm had done full-blown CFD using Sweden's biggest cluster of PCs, which took several weeks,' he said. 'We did the same analysis on a laptop in an hour. It agreed to within five per cent.'

Juniper believes that InstaFlow could offer Rolls-Royce a significant advantage in the gas turbine industry. 'We went for a very ambitious project, applying this to something as big and complicated as a jet engine fuel injector,' he said. 'I'm surprised at how well it works, but perhaps not as surprised as many.'

Matthew Juniper's website can be found at www2.eng.cam.ac.uk/~mpj1001/MJ_biography.html

Stephen Fry Talks Tiny

How tiny is 'Tiny'? Well it's nano, and nano is everywhere.

It gives butterflies their colour and geckos their sticky feet; it can make water-proof plants and honey-proof spoons; help us cure diseases and help stop climate change. Nano can even let us hear atoms "sing" and maybe one day connect our brains to the internet. You can learn more by watching a newly completed short film funded by the EC and the Department's Nanoscience Centre. The film entitled NanoYou gives an introduction to the strange world of Nanoscience and is narrated by Stephen Fry.

NanoYou is an educational portal which provides online resources for teachers, young people and those interested in an introduction to nanoscience. Other partners are from a range of countries and educational and societal areas which include the European Schoolnet in Brussels and the Barcelona Science Park. The Nanoyou website is packed with other nano resources, including a virtual nanotechnology lab, hands-on activities for the classroom and games.

The video was showcased at the end of January to a group of teachers from across Europe and from which it received amazing reviews. UK teachers who have seen it have described it as "absolutely great – stunning images, well-presented" and as "captivating" by one A-Level teacher who used it with her class. Another wrote especially to congratulate the Centre saying "found this today and showed it to my Year 11 GCSE chemistry class. FABULOUS video, thanks so much, a squillion times better than the majority of "made for school science" videos which are so often awfully dull. Wonderful stuff and lovely Stephen Fry to boot.

Visit the NanoYou website for online teaching and educational materials about nanotechnology at: <http://nanoyou.eu/>

The NanoYou film can be found on the University UTube site at www.youtube.com/cambridgeuniversity

Paper on 'tsunami resistant' houses wins the Institution of Civil Engineers Bill Curtin prize

The Asian tsunami of 26 December 2004 showed the catastrophic devastation that could be caused by a tsunami to human lives, infrastructure and economy.



Scale model of a typical Sri Lankan house

The tsunami claimed more than 220,000 lives and made almost 800,000 people homeless. The total economic cost of the catastrophe is estimated to be more than £7.5 billion. A paper by Dr Indrasenan Thusyanthan, former Lecturer in the Geotechnical Research Group and Dr Gopal Madabhushi, Reader in Geotechnical Engineering presents the results of model tests that compare the impact of a tsunami wave on a typical coastal house with that on a new 'tsunami resistant' design developed in the USA and now built in Sri Lanka. The paper has won the Bill Curtin prize awarded by the Institution of Civil Engineers (ICE) for the Best Paper in the ICE Civil Engineering magazine.

While earthquakes and tsunamis are inevitable forces of nature, it is possible to be better prepared for them so that the damage to infrastructure can be minimised. To save lives, efficient tsunami-



Scale model of the tsunami safe house

warning systems need to be put in place for the evacuation of people from coastal areas. The physical, economic and financial loss to the coastal community can also be reduced by having tsunami resistant designs for houses and other infrastructure in the region.

Understanding tsunami wave loading on coastal houses is important to improve the design of coastal structures. The paper presents the results of physical model tests of coastal houses subjected to tsunami wave loading in a 4.5 m long wave tank. 1:25 scale models of a typical Sri Lankan coastal house and a new house design were tested in the tank, in which the near-shore tsunami wave conditions were created.

The new house design, named the 'tsunami-resistant house', was designed by a student initiative at Harvard Design School in collaboration with the

Massachusetts Institute of Technology (MIT). Instead of four solid walls with small openings for doors and windows used in conventional design, the new design has centrally placed doors facing the sea and the corner walls are made of reinforced concrete. The basic design concept was that these houses would allow the passage of the tsunami wave, through the central part of the house, without attracting too much hydrodynamic loading.

The Bill Curtin Medal was instituted in 1992 following a donation by Curtin's Consulting Engineers to commemorate the late W G Curtin's contribution to engineering. The medal is awarded annually for the best paper published by the ICE describing innovative design in civil engineering.

The prize winning paper in the ICE Civil Engineering magazine can be downloaded as a PDF at:
www.eng.cam.ac.uk/news/stories/2010/ICE_Bill_Curtin_Prize/Thusyanthan_et_al_2008_Tsunami.pdf

A poster with more detail on this work can be downloaded as a PDF at:
http://www.eng.cam.ac.uk/news/stories/2010/ICE_Bill_Curtin_Prize/Tsunami_Thusyanthan.pdf

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it206@cam.ac.uk

Best Maritime Technology Student

Recent graduate Ben Sheppard has won a prestigious Science, Engineering and Technology Student of the Year Award

The Science, Engineering and Technology Student of the Year Award is one of Britain's most important awards for science and engineering undergraduates. Ben won the Best Maritime Technology Student award which is sponsored by Lloyd's Register Educational Trust, and was partly in

recognition of Ben's excellent MEng project on a low-cost deep-sea photographic vessel, supervised by Digby Symons.

More information on Ben's project along with a gallery of photos can be found at: www.projectpebble.co.uk



Ben Sheppard receiving his prize from John Carlton

Expanding school resources on Carbon Footprinting

Inspired by a fourth year undergraduate project by Chris Cleaver in 2007/8 on Eco Footprinting in Schools, Professor Peter Guthrie FREng (Professor of Engineering for Sustainable Development), hosted two Year 11 school students for four weeks over the summer.

The students, Steph Jezewski and Natosha Kilby, were given the task of expanding the teaching resources about Carbon Footprinting that they used in their school, and creating new resources suitable for primary schools. They have developed resources for both Infant and Junior Primary schools. They then pilot-tested the resources in two local primary schools in September.

The student placements were organised and funded by The Nuffield Foundation's Nuffield Science Bursaries. The Foundation offers bursaries to first year post-16 science, technology, engineering and maths (STEM) students, up to 1000 funded places a year, so that students across the UK can get an insight into the world of scientific research and development, including areas of technology, engineering and maths. Through the scheme, students take part in STEM based projects, lasting 4-6 weeks, in universities, industry or research institutions during the summer holidays. Students work alongside practising scientists, technologists, engineers and mathematicians.

Peter and his team were most impressed by the students' work and believe that it could form the basis of a widely adopted national schools scheme for (a) improving environmental performance at schools and (b) raising the awareness of the importance of engineering in solving many of our environmental problems. The 'resource packs' they have created are very attractive and attention-grabbing.

The students presented their resource packs to some engineers in the Department. Following the positive feedback that this received the students have sent a DVD of their presentation to the Royal Academy of Engineering to see if it is something they would like to take further. Natosha and Steph had a presentation evening with all the other NuffieldScience Bursary Students and went on to enter their project for a CREST (CREativity in Science and Technology) award. They won Best Silver award in the Engineering/Technology category. CREST is a nationally recognised



Steph Jezewski and Natosha Kilby

scheme to reward Science & Technology project work. Peter said "What was particularly good about this project is that the students did such excellent work largely unsupervised and they managed to produce a huge amount of work that impressed everyone. They are not planning on being engineers in the future so they had a completely different outlook on tackling the subject. One of the highlights was that they created two stories for infant age children. This was a fantastic idea and really impressed all the staff here. Many wanted a copy there and then." The students were supported during their time at the Centre for Sustainable Development by Victoria Hickman (PhD student) and Bethanie Wattleworth (Engineering Undergraduate).

To find out more about hosting a Nuffield Bursary student, please contact Elizabeth Crilly at STEM Team Cambridgeshire.
t: Direct line +44 (0)1223 416596
e: elizabeth@stemteamcambridgeshire.org.uk
www.nuffieldfoundation.org/go/grant/nsb/page_390.html

GB Pioneers

Mark Sweeney, a PhD Student in the Department's Combustion Research Centre, was selected to play for the GB Pioneers student rugby team against Norway.

The Pioneers are a selection of student rugby league players drawn from 14 different universities across the UK, with equal representation from Ireland, England, Wales and Scotland. They travel to nations where rugby league is emergent to train with, and play a test match against, the national side, in order to assist the development of the sport there. The trip involved joint training and educational sessions with the Norwegian players before the test match in Oslo.

Selection is based on a combination of rugby league ability, dedication to the development of rugby league within the student's university, and interpersonal skills. University coaches can make recommendations to the selectors, and final selection is based on this and personal interviews with the candidates. The Department has very strong representation in the University's Rugby League team (three PhD students and two undergraduates from the Department were varsity winners last season).

Since their inception the Pioneers have provided the first taste of international competitive Rugby League for emergent Rugby League nations. Essentially the Pioneers act as the first step on to the international scene.

They have laid the foundations for countries to develop Rugby League and now each is participating in either European Shield or European Bowl competitions.

Gerard Keenan, Team Manager commented, "The Pioneers are a unique development concept. Our students continue to break new territory. Their desire is not only to play Rugby League but to teach others and share their love of this fantastic sport."

Mark is currently working on his PhD in stratified combustion in the



Department's Hopkinson Laboratory. He says; "It is great to be able to combine academic work at the highest level with extra-curricular pursuits such as this."

Photo competition captures engineering's burning issues

Nano-sized beauty, cutting-edge scientific advances and glimpses of remarkable humanitarian initiatives in distant parts of the world have all been captured in this year's Engineering photo competition.

The Department's annual contest invites anyone who works here – whether they are a Professor, student, or a member of the support staff – to submit a photograph connected with their day-to-day work.

The results represent an array of subjects, showcasing both the research and teaching that takes place within the Department and work undertaken by its staff in the field.

Together, the 165 entries cover an extraordinary range of themes, revealing the breadth of research undertaken by engineers at Cambridge Microscopic Images, some covering materials only nanometres in length and utterly invisible to the naked eye, including extreme close-ups of human bone cells, nano-tubes, electronic beams, concrete particles and even faecal pellets.

A photograph of pollen is aptly named *Space Invaders* due to its extra-terrestrial appearance when enlarged through the microscope's lens. Elsewhere, pictures capture bubbles at the moment of bursting and flickering methane flames, while a breathtaking image, *The King Waves Goodbye*, shows a bullet slicing through a playing card, decapitating a King of Diamonds with incredible precision.

Aside from the work in the laboratory, photographs taken during fieldwork pay tribute to the structural accomplishments of engineers, showing constructions including the Imerys China Clay Pit in Cornwall and the world's biggest hydraulic dam.

A solar car, named *Endeavour*, which was designed by the University's Eco-Racing Team, can be seen hurtling across the Australian outback during the 2009 Global Green Challenge.

Yet more images reveal how the work of engineers is helping to change lives, particularly in the developing world. Particularly moving is a series of photographs taken in Panama, Zambia and Kenya, which depicts the problems of inadequate drainage and water supply infrastructure in those countries.

The entire collection of photos is available for viewing in high resolution on the Department of Engineering's Flickr site: www.flickr.com/photos/cambridgeuniversity-engineering/

First prize

Rob Gordon's 'Aircraft engine flame-out'



The winning photo: Aircraft engine flame-out

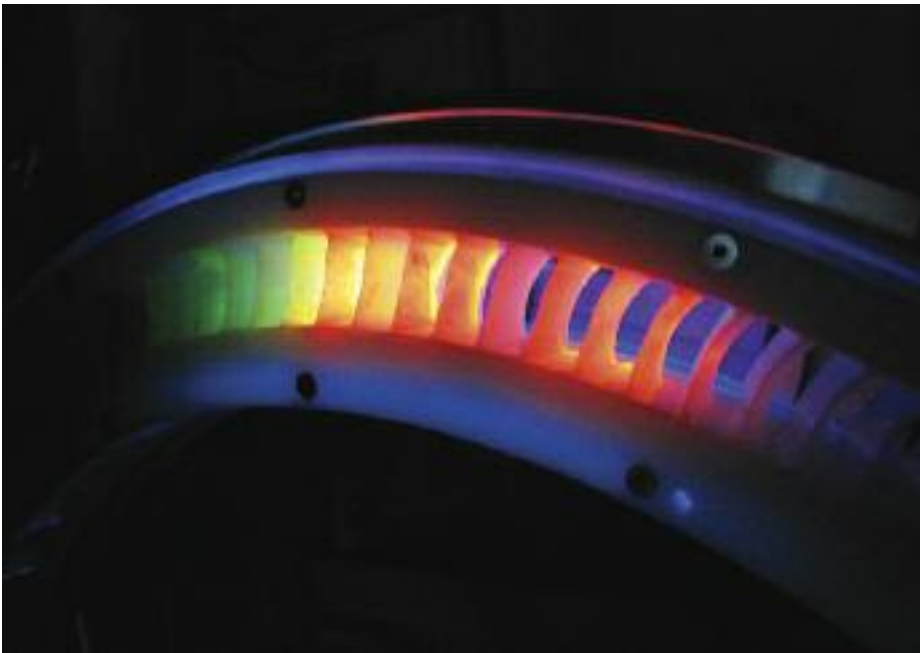
First prize in the 2010 competition went to Rob Gordon's *Aircraft engine flame-out*, which portrays a flame struggling for existence milliseconds before it was extinguished by freezing air.

Inclement weather or other unforeseen circumstances could cause the flames in aircraft engines to extinguish, with a subsequent loss of power. In order to design against this unlikely but serious event, aircraft engine designers must research the physics of flame extinction.

The photograph is taken a few tens of milliseconds before the flame extinguishes. It is a composite false-colour image, where the bright outer area is the light from a thin laser sheet, scattered from micrometer-sized olive oil particles carried by the fuel-air mixture as it enters the combustor. The inner, darker region is light from the flame itself, struggling to survive as the fast cold air eats away at it. The temperature drops, and this allows the olive oil particles which are normally consumed within a flame to be visible progressively throughout the combustor, denoting flame extinction. The photo is part of a sequence that contains both the stable flame and the blow-off event, taken by two high speed CMOS cameras at 5000 frames per second.

Second prize

Ivor Day's 'Turbine Wheel'

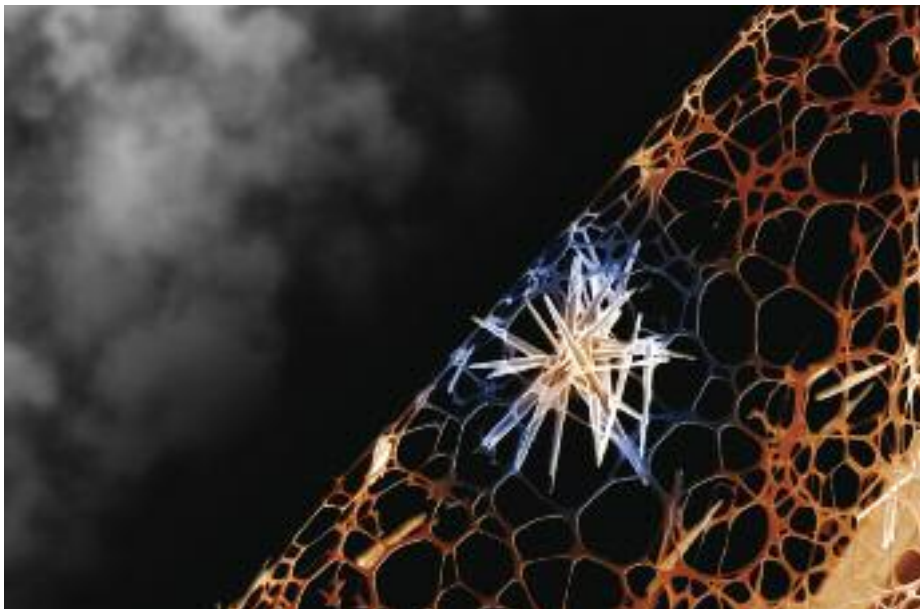


Second prize: Turbine Wheel

The second prize was awarded to Ivor Day's photo, Turbine Wheel, which is one of hundreds taken while investigating the aerodynamics of a set of turbines. The blades were painted with brightly-coloured poster-paint mixed with light oil and then spun. The beautiful spectrum in the image was produced by examining the resulting flow lines on the blades using ultra-violet light.

Third prize

Rami R. M. Louca and Yun Thai Li's 'Crystalline Entity'

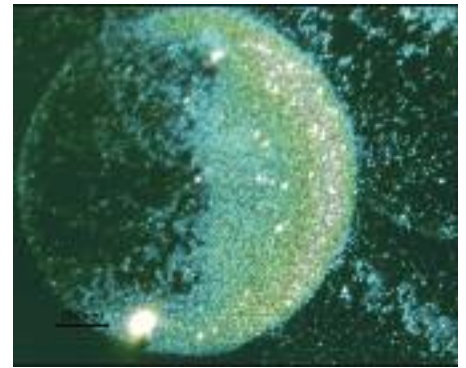


The third prize photo: Crystalline Entity

Crystalline Entity by Rami R. M. Louca and Yun Thai Li gained third prize. The star-shaped crystal in the picture resembling a strange celestial body is actually zinc oxide on a supporting mesh made of amorphous carbon.

The photographers are researching material used in transistors, light emitting diodes and solar cells. Ultimately, this could mean the development of cheaper alternatives to the existing technology used in computers, mobile phones and solar-powered chargers, among other items.

Some other notable entries



Felice Torrisi - 'Nano moon'



Arnaud Bonin - 'Membrane wrinkling'



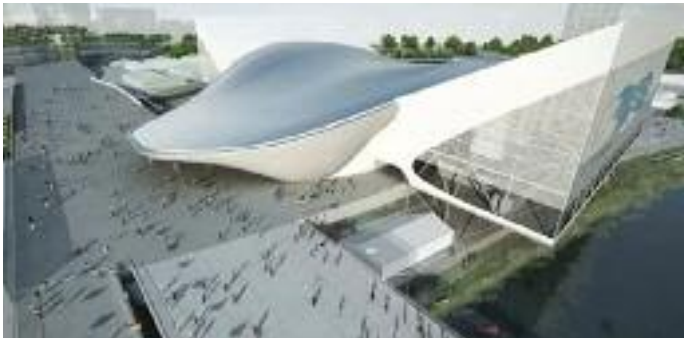
Rebecca Ward - 'Starting Vortex Pair'

Some of the photos have been featured by the Telegraph website: www.telegraph.co.uk/science/picture-galleries/7887634/The-Carl-Zeiss-Photography-Competition-at-Cambridge-Universitys-Department-of-Engineering.html

The competition was sponsored by the electron microscopy division of Carl Zeiss, a field leader in optics, precision engineering and electronic visualisation. The panel of judges comprised Roberto Cipolla (Professor of Information Engineering), Allan McRobie, Professor Dame Professor Ann Dowling (Head of Department), and Philip Guildford (Director of Research).

Olympic Park London

Students from the Centre for Sustainable Development visited the London 2012 Olympic and Paralympic Games site to see how large infrastructure projects are developed.



Aquatic Centre



Aquatic Centre construction

The day was organised with alumna Kirsten Henson and gave an insight into the sustainable initiatives built into the project. Kirsten was an undergraduate in the Engineering Department and returned later to undertake the MPhil in Engineering for Sustainable Development in 2005/6.

The students heard talks from some of the major contractors working on the project, including Atkins, Aggregate Industries and Balfour Beatty. Kirsten, who now works as Sustainability Team Materials Manager for the Olympic Delivery Authority (ODA) Delivery Partner, CLM (the consortium made up of CH2M HILL, Laing O'Rourke and Mace), introduced the day by discussing her role on the project and the innovations that are integral to the Olympics. The Games are aiming to be the most sustainable Olympics and Paralympics yet, with ambitious targets to minimise the environmental impact of the Games and associated activities. These include:

- 50% reduction in carbon dioxide emissions associated with the Olympic Park and venues by 2013.
- 90% of demolition material to be reused or recycled and at least 20% of materials used in permanent venues, associated works and the Olympic Park, to be from a recycled source.
- 40% reduction in the demand for potable water in permanent venues and a 20% reduction target for residential development.
- 80km of walking and cycling routes and to aspire to 50% of construction materials to be transported to the Park by water and rail.

A major theme of all the companies' work is the legacy for East London. London Olympics claim 1,500 UK businesses have won around £5 billion of Games-related contracts and 25 domestic commercial partners have signed up to the London 2012 programme.

The legacy for the surrounding area is a key design goal, with the Olympics and Paralympics described as merely significant milestones on a project that intends to transform London for decades to come. Given this requirement to design for 'legacy', there are a number of innovative design approaches being deployed. Innovations include a non-potable water supply network, a Combined Cooling and Heating Plant (CCHP) on site, a 2.5MWe (megawatt electrical) Wind turbine and a 3MWth (thermal megawatt) biomass boiler in the Energy Centre. Much is made of the fact that the project is to be in two phases, an Olympic phase and a 'legacy' phase. This involves part of the Olympic stadium, Aquatic Centre and some bridges being

removed at the end of the games. Much work has gone into the landscaping of the area post games, with many bird and bat boxes being discreetly hidden on site.

The day concluded with a tour to see the progress made. The skeletal structures of the main stadium, the Velodrome, and the Aquatic Centre are already in place. With a little imagination, it is possible to see not the busy construction, but a green park filled with pedestrians, a long way from the east end industrial wasteland it was only three years ago. It is good to know that an engineer from the Centre for Sustainable Development is at the heart of providing an exciting, natural open space in one of the busiest cities in the world.



MPhil students at Olympic Park

The LRET support for scholarships

The Department of Engineering is delighted to announce generous support from The Lloyd's Register Educational Trust (The LRET) for a scholarship for the MPhil in Engineering for Sustainable Development for the first year from 2010. The LRET, an independent charity established in 2004, supports advances in transportation, science, engineering and technology education, training and research worldwide for the benefit of all. It also funds work that enhances the safety of life and property at sea, on land and in the air. In addition The LRET is supporting MPhil scholarships in Micro- and Nanotechnology Enterprise and Scientific Computing, both at the University. The Department looks forward to working with The LRET over the coming year.



Ideas take flight for Suffolk pupils

A hundred children, aged 11-13, from Suffolk middle schools spent a day at Cambridge University learning about the science of flight.



The trip was organised jointly by the Gifted and Talented Waveney Schools Project in Suffolk and St John's College, Cambridge, to enrich the school curriculum in maths and science and give pupils a glimpse of university life.

Taking part were year 7 and 8 pupils from six schools – five state schools and one independent school – all in the Waveney Valley. Their day began with a talk by Paul Thomas, a researcher at the Whittle Laboratory, who spoke about the maths and physics behind flight and gave an overview of possible careers in engineering.

After lunch the students walked to the Department of Engineering to put what they'd just learned into practise by making their own gliders using basic materials such as card, polystyrene, tape, paper clips and plasticine. Activities were coordinated by the Department's Outreach Officer Joy Warde and a team of volunteer student helpers.

Their designs – which varied from bi-planes to jumbo jets – were put to the test in one of the lecture theatres where the most elegant gliders flew a distance of 25 metres to shouts of applause. Those that were too heavy crash-landed into the seating; those that weren't symmetrical or

properly balanced flew at a tangent and hit the walls.

"The best thing about the day is making things ourselves," said Cameron Read from Halesworth Middle School. He was hard at work with scissors and tape with his co-designer, Ben Bradshaw. "Our first glider smashed into a wall and fell to bits – now we've got just five minutes to make a new one," he said.

Antony Chambers, another pupil from Halesworth, said: "This is great fun for me because I might want to be a pilot in the future. I'm good at maths and I've been on a flight simulator in Germany – and they said I did well. The talk from Paul was really interesting."

The pupils' verdict on Cambridge was positive – and that included the vital matter of food. "The lunch at St John's was really good – a buffet with sausage rolls, chicken and éclairs," said Antony's friend, Jens Stohr, with genuine appreciation.

The visit was part of a programme designed for Waveney schools by Beth Derks and Wietske Bohncke of www.nodoubledutch.com. Beth said: "One of the main aims of the project is to raise the aspirations and attainments of gifted and talented students in science and maths, and give them a glimpse of the opportunities that exist in engineering, and what better way of doing that than to give them hands-on experience in an inspiring setting. On the coach home pupils and teachers were buzzing with excitement."

All arrangements in Cambridge were made by Chris Cotton, Schools Liaison Officer at St John's College. He said: "We're able to act like a bridge between schools and the outreach resources that exist across the departments. In this case, we put together a programme that offered both a social and academic experience with insights into several aspects of Cambridge – including college life and research – with the accent on putting learning into action."

Department's Outreach work receives gift

The Alan Reece Foundation has generously donated £120,000 to secure the post of Outreach Officer for the next three years. Dr Joy Warde, holder of the post, says "this gift now means I can concentrate on building up our Outreach resources and encouraging more and more young people to get involved in engineering". Dr Alan Reece, industrialist, inventor and former academic, set up the Foundation with the vision of furthering British engineering and manufacturing.

Gareth Keeves awarded the highest mark worldwide

An engineering student at the University of Cambridge has beaten hundreds of fellow scholars across the world in a prestigious examination. Gareth Keeves, 21, was awarded the highest mark worldwide for the Diploma in Financial Management.



Gareth, in his final year of a Manufacturing Engineering course at the Institute for Manufacturing (IfM), came top out of a total of 1,022 students taking the DipFM course.

The diploma, run by the Association of Chartered Certified Accountants (ACCA), is aimed at middle or senior managers in non-accounting roles and gives them a working understanding of finance and the ability to work confidently with financial information.

Students on the IfM's Manufacturing Engineering Tripos take the course as part of their studies in order to understand the financial aspects of business leadership. A modest Gareth said: "I was completely taken by surprise when the certificate came through, but absolutely delighted with the result."

Dr Claire Barlow, course director for MET says: "This is clearly an exceptional achievement and one that Gareth should be very proud of. "Wyn Mears, director of ACCA UK says: "It is to Gareth's credit that he has done so well in these exams in such a short time. The papers and projects within the DipFM are very challenging and to have come top in such a competitive environment is exceptional."

Interdisciplinary Design for the Built Environment (IDBE) masters course

The Structural Engineer magazine recently published an article about the Interdisciplinary Design for the Built Environment (IDBE) masters course, a part-time Masters Degree offered jointly by the Departments of Architecture and Engineering.

One of the underlying principles of the course is that sustainable design of the built environment demands effective interdisciplinary understanding and collaborative working. One of the key aims is to help students from different disciplines work effectively together, harnessing their knowledge and expertise in the design and delivery of an integrated product. The article is reproduced below with kind permission of the Institution of Structural Engineers Educational Trust.

Promoting teamwork and sustainable design

The IDBE Masters programme offers practising professionals a structured process of interdisciplinary education and professional development. Julie Jupp and Sebastian Macmillan, who run the course at Cambridge University, explain.

We often take the built environment for granted without realising the benefits it brings. It clearly influences our quality of life; well designed schools contribute to educational attainment, hospitals to patient outcomes, offices to productivity, public open space to recreation and well-being, while attractive towns and cities generate civic pride and tourism. The converse is also true; more policing and healthcare are needed where the built environment is poor.

Alongside the issue of social outcomes is the increasingly important risk of environmental impact, including climate change. We urgently need to be providing facilities that minimise resource use in their construction, minimise energy and water requirements, and limit damage to the natural world.



During the residential weeks, students tackle a design project in small mixed discipline teams

Traditionally, some of these abilities develop with experience. But commercial pressures are often such that individuals can now find themselves in positions of considerable responsibility early in their careers. Most of those taking the course have demonstrated their abilities in their core disciplines and are moving to strategic and leadership roles for which they may well be under-prepared. The course provides a route for accelerating progress towards professional maturity.

The objectives of the course include giving students a strategic overview of the construction industry and of the production and management of the built environment, as well as a critical perspective on the everyday knowledge and assumptions made in practice. The course also raises awareness of current research in the sector and its potential and limitations, and provides an introduction to professional ethics and the responsibilities owed by engineers and their colleagues to society as a whole.

Various practical skills are promoted including leadership and the effective management of teams, competence in negotiating, and effective communication and presentation skills. A reflective attitude is encouraged that may include developing awareness of the different and sometimes conflicting motivations and value systems of other designers, of clients, and of wider project stakeholders.

Course organisation and origins

IDBE is a 2-year part-time masters course offered jointly by the Departments of Engineering and Architecture at the University of Cambridge. Students joining the course attend two separate residential weeks in Cambridge over the 2-year period. Each of the weeks has a distinctive theme, which is examined through formal lectures, workshops, discussions groups and crucially, a studio design project undertaken in small mixed-discipline teams. Between the residential weeks and away from Cambridge, students complete four written assignments including a 15,000 word thesis in the second year.

The course has its origins in the ideas of Ove Arup, not only his passion for 'total design' but also his view of the importance of successful interdisciplinary collaboration. These views can be traced back to the

1930s when he found himself, as an engineer with detailed knowledge of the properties of reinforced concrete, teaching architects about its structural possibilities. Throughout his career Arup wrote extensively about the need for better collaboration between architects and engineers and, when the Arup Foundation was established to honour his memory, its objectives included an emphasis on the multi-disciplinary nature of design in engineering and architecture.

The Foundation Trustees perceived a need for an initiative to bring professionals in the built environment together to study with a set of common objectives, supported by leading academics and industry practitioners. The learning experience was not to be limited to specific disciplines but extended to the humanities to help broaden the participants' outlook. These ideas were examined at a seminar at Madingley Hall in Cambridge in 1991. Several higher education establishments were invited to put forward expressions of interest and, after an exhaustive selection process, the Foundation agreed to support the Cambridge proposal for IDBE.

Consequently the course was established at Cambridge and admitted its first cohort of students in July 1994. It was the first part-time course at Cambridge, but has since been joined by half a dozen others. Since its inception more than 150 students have graduated from the course. Additional financial support in the early years was generously provided by the Happold Trust and the Isaac Newton Trust, and many engineering students on the course gain support from the Panasonic Trust.

The early years of IDBE coincided with the publication of the Latham and Egan reviews of the performance of the construction industry. Many of the ideas in both reports were entirely compatible with the objectives of the course, and IDBE helped to deliver the 'rethinking construction' agenda to professionals taking the course. Since that time, the sustainability agenda has become increasingly important nationally and internationally, and course content has evolved to make sustainability a major component. There is no loss of ambition in this change. We take the view that

sustainability is not under the control of any single discipline but instead needs all disciplines to share a vision and to work effectively together to deliver it. Sustainable construction needs integrated teams.

Who takes the course?

The entry requirements for those taking the course are for a minimum of three years post-qualification experience. In practice, most of those taking the IDBE course have more than this, most are qualified professionals with at least five years experience.

The course recruits up to 25 students a year, of whom about one third are engineers (structural, civil, and building services), one third are architects, and the remainder are from related disciplines such as surveying, project management, real estate, planning, landscape architecture, and so on. Up to one third are international students. About a quarter are female, and we should be pleased to see this number rise.

Recent graduate and recipient of an IStructE Educational Trust Bursary, Fiona Cobb, said: 'While I had slight reservations about how the mixture of students would affect my experience on the course, the group debates generated by this mix have been one of the highlights. The course was an immense benefit and I always left the residential periods with my head buzzing with new ideas. I made numerous friends and contacts and was sorry when I reached the course's conclusion'.

Educational Trust Bursary

The Institution's Educational Trust sponsors an annual bursary for a structural engineer on the IDBE programme. Since its introduction six students have benefited from the Educational Trust bursary which has proved successful in assisting talented young engineers. Kate West has provided the following feedback on her experience.

Kate West, Structural Engineer and Design Team Leader at Arup

After seven years practising as a structural engineer and as an Associate with Arup (London office), I am now working in a new Design Team Leadership (DTL) role. When I started the course, I was working in this emerging area as an Assistant DTL on the €609million Dublin Airport T2 project. Two of the key reasons I undertook the IDBE course were to expand my understanding of other AEC professions and to develop my leadership and integrated design skills. Using the knowledge gained on the course in conjunction with my earlier DTL experience, I've helped to develop the new Arup group which focuses on the delivery of design team leadership services. Now as a DTL of large projects, I am more able to

effectively lead multidisciplinary teams. One of my most recent career highlights was leading the €400 million Dublin Northern Quarter urban regeneration scheme where I was responsible for over 35 designers, comprising architects, engineers and specialist consultants.

Employers and fees

Fees for taking the course are typically met by employers, although sometimes they are shared by employer and employee, and some students put themselves through the course. For employers, the benefits are several:

- First, sending a student on the course demonstrates confidence in the employee and a willingness to invest in training and development.
- Second, after each of the residential weeks, employees return to their companies refreshed and invigorated by the experience of the week and with new ideas that can cascade through the firm.
- Third, the written assignments undertaken may readily benefit the organisation.

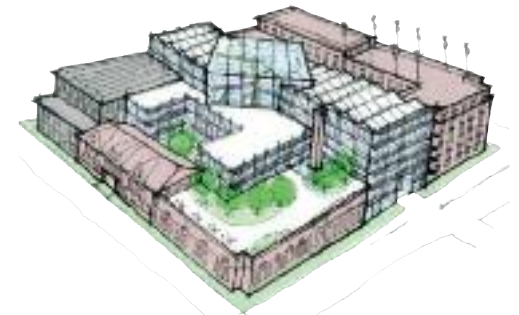
Recent examples include a student who undertook a pilot study in a potential client organisation and whose firm was subsequently commissioned for a fully professional survey. Another's thesis included a spreadsheet of facts and figures about 'embodied energy' in various building elements, and his company is now offering this as a new service to clients. Another completed a client satisfaction survey, and yet another reviewed 'sustainable energy technologies' and turned this into a business plan for a new consultancy. Provided the assignments meet the academic standards expected, they may serve this dual purpose.

A typical week in Cambridge

No week on the course is the same as any other. But to give a flavour, a recent week had as its theme urban design and sustainable communities. Lectures were given by Diane Haigh of the Commission for Architecture and the Built Environment (CABE), and university lecturers presented three research projects: 'Conflict in Cities', 'Transport Modelling', and a socio economic study of Cambourne. Planner Peter Studdert reviewed new Northern European settlements, and Alex Plant spoke about Cambridgeshire Horizons. Architecture critic, Hugh Pearman, led a discussion about iconic buildings. The studio project looked at the planned expansion of the city of Abu Dhabi. Plan Abu Dhabi 2030 outlines a framework for the expansion of urban areas onto existing islands and the mainland so as to diversify the economy and expand the population. Working in mixed discipline



Two proposals for the Department of Engineering

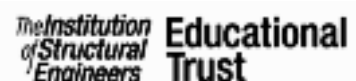


teams the students explored one of five urban planning themes, including the creation of new districts as well as the design of public open spaces and transport systems.

Buro Happold Senior Engineer and member of the 2007-2009 cohort Paulo Silva, said: 'With many of us working on projects in the Middle East, it was a great opportunity to build on our local knowledge and more importantly, appreciate some of the broader best-practice issues that are sometimes left behind in the rush to site. This is typical of the IDBE course, which has been an excellent learning experience. I often find myself subconsciously using this new learning whilst at work, as the course has given me a much broader perspective of the issues that can and should shape our industry.'

The IDBE website provides a good deal of information about the course and illustrates some of the studio projects undertaken during the residential weeks. It also contains information about the syllabus and how to apply to join IDBE.

**The IDBE website is at: www.idbe.org
This article was reproduced by kind permission of the Institution of Structural Engineers Educational Trust:
www.istructe.org/thestructuralengineer**



Superconductor breakthrough could power new advances

A new approach to producing high-temperature superconductors could drive down the cost of MRI scanners and protect infrastructure during energy surges.

The first in a new range of powerful superconductors which could revolutionise the production of machines like hospital MRI scanners and protect the national grid has been developed by scientists. Engineers at the University of Cambridge used new techniques to manufacture high-temperature superconducting materials, producing samples that can carry record quantities of electrical current for their type and size.

The breakthrough has improved the effectiveness of yttrium barium copper oxide (YBCO) and a related family of superconducting materials. It raises the prospect of more powerful and affordable samples that could have huge benefits in a number of fields. Superconductors are materials which, when cooled to a certain temperature, can carry an electrical current without losing energy in the process. This makes them different from standard conductors, such as copper wire, which resist the flow of current with the result that some energy is lost.

In the long term, this means that superconductors could have important environmental benefits by increasing energy efficiency. At the moment, up to 10% of the electrical energy generated by British power stations is lost before it reaches the user because of resistance in the power lines. Superconductors offer no such resistance, could be used to store large quantities of energy until needed, and in some cases can carry 100 times more current than copper. The current also generates a magnetic field, which means that superconductors can be used in numerous other applications. These potentially include MRI scanners in hospitals, "magnetic separators" which cleanse sea-water and lakes, high-speed monorail trains, mechanical flywheels that store energy and, famously, the Large Hadron Collider.

At present, however, effective superconductors are often expensive and difficult to mass-produce. The Cambridge research could be a step towards resolving this, by providing the basis for the development of more powerful samples that can be manufactured using a commercially compatible process. That

would drive down the production costs of machines that rely on the materials. MRI scanners, for example, which can cost around £1.5million each, could eventually become a common sight in GP's surgeries, helping to improve accurate detection and diagnosis of problems ranging from twisted knees to brain tumours.

Superconductors can also act as "fault current limiters" within the national grid, protecting it from the energy surge caused by a sudden rise in consumption. These surges, which caused blackouts across the east coast of the US in 2003 and Europe in 2006, can cause lasting damage to both the grid and public infrastructure. Superconducting materials will cease to conduct without significant energy loss if there is a particularly large current, however, meaning that they can be built into the system to shut down the electricity before it reaches the point of use.

"The potential advantages of developing viable high-temperature superconductors are huge," Professor David Cardwell, head of the bulk superconductivity group at the University's Department of Engineering, where the research took place, said. "The processes we have developed and patented should enable us to develop samples that are better, bigger, cheaper and more reliable."

While some materials need to be cooled down to as low as -269 degrees centigrade to superconduct, YBCO does so at the comparatively "high" temperature of -181 degrees C. This means that it can be cooled with liquid nitrogen, rather than liquid helium, which makes it cheaper to operate. In the past, however, producing effective bulk superconducting devices from the material has proved difficult.

YBCO is processed most easily in the form of a polycrystalline ceramic, but has to be manufactured as a single grain in order to generate large magnetic fields since boundaries between grains limit the flow of current in the bulk sample. In addition, microscopic defects within the material can impede, or 'pin' the motion of magnetic flux lines and increase the flow of current through it. The distribution of these lines within a bulk superconductor has to be managed to maximise the flow of current



and therefore the field.

The Cambridge team have developed a technique to manufacture large single grains of bulk superconductors that involves initially heating the material to a temperature of 1,000 degrees C, causing it to part-melt. In a series of experiments, various elements, such as depleted uranium, were then added to the chemical composition of the superconductor to generate artificial flux pinning sites within the single grain. When the material cooled and reformed, these added materials retained their integrity and formed physical obstacles that direct the motion of magnetic flux lines, enabling larger currents to flow.

In addition, the team developed a technique for fabricating large, single grains of bulk superconductors in air, using a new type of seed crystal that they have also patented, which enables much more scope for optimising the partial-melt process. Together, these techniques led to the production of samples far more powerful than those fabricated by more standard techniques, which exhibited record energy densities and magnetic fields for their size.

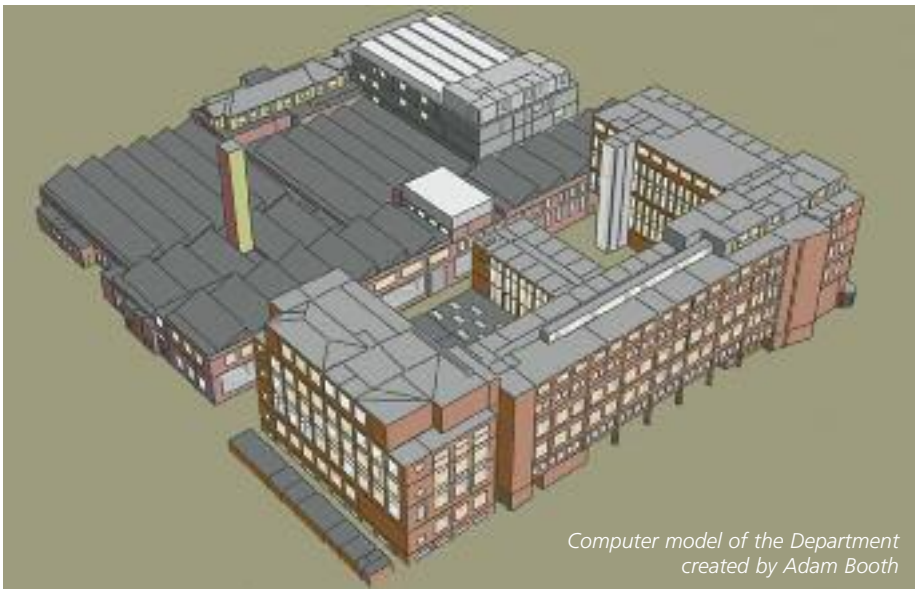
"The properties these samples exhibit could in time offer huge commercial potential by improving or reducing the weight and size of applications such as energy storage flywheels, magnetic separators, motors and generators," Professor Cardwell added. "These devices already use superconductors to varying degrees. With these new bulk processing techniques, we could greatly improve their power and potential."

David was interviewed on his work on BBC Radio 4's Today programme and the interview can be heard at: http://news.bbc.co.uk/today/hi/today/newsid_8803000/8803020.stm

David discusses the possibilities and demonstrates some of the materials' remarkable magnetic properties in a short film on the University's YouTube channel: www.youtube.com/cambridgeuniversity

Modelling energy use in the Department

Adam Booth, a recent engineering graduate, has created a computer model of the Department that is able to simulate how energy is used in the buildings and predict the effect of proposed changes.



Adam began creating the model as part of his fourth-year project, entitled "Modelling and Simulation of Building Physics", which was supervised by Allan McRobie of the Civil, Structural, Environmental and Sustainable Development Division. The project concentrated on improving the thermal comfort of office spaces in the Department and looked at measures for reducing the heating demand for these areas, such as superior glazing or heat-recovery ventilation systems. Adam's project also investigated the cost-effectiveness of these technologies, and put the need for energy efficient buildings into the wider context of combating climate change.

The thermal model of the Department built by Adam uses commercially available software called "Virtual Environment" created by the company Integrated Environmental Solutions, which is used by many engineering companies to predict the environmental performance of buildings that they are designing. Adam learnt how to use this software during previous summer work placements at building services company Zisman Bowyer and Partners, and more recently at engineering consultancy Buro Happold.

Many people were very impressed by the work done by Adam for his fourth-year project, including the University estate managers and David Green, who is in

charge of building services within the Department. As a result, Adam was commissioned by the Department to undertake further investigations over the 2009 summer holiday period into the energy use on the Trumpington Street site.

The investigation concentrated on four case studies within the Department, with an analysis of various ways of reducing the demand for heating and improving the energy efficiency in large spaces such as lecture rooms and laboratories. It was found that in most areas of the Department, energy use for heating could be reduced by 50% with fairly well-established technologies. The results of these investigations are now being used to inform key decision-makers on how to invest in future work on the Department buildings and make the Department a shining example of energy efficiency.

Adam has gone on to start a PhD here as part of the new Energy Efficient Cities Initiative (EECI), under the guidance of Dr. Ruchi Choudhary, in which he will be investigating building technologies as part of a multidisciplinary team that aims to strengthen the UK's capacity to address energy demand reduction and environmental impact in cities.

Adam Booth email: atb29@cam.ac.uk

Civil engineering student Christopher Matthews wins £1,500 prize

Inspire Scholar and civil engineering student Christopher Matthews collected a national prize, worth £1,500 from ConstructionSkills, the Sector Skills Council for the construction industry.

The Cambridge undergraduate beat off stiff competition to be crowned winner of this year's Inspire competition, which gives some of the brightest new talent in the industry the opportunity to explore how they would convince young people to embark on a career in construction.

The competition required entrants to sell the construction industry as a positive career choice demonstrating enthusiasm for construction and the built environment, in a fun and interactive way. Entrants had to imagine they were taking part in a television show for a careers programme, with three minutes to sell their favoured profession and the industry as a career choice to any potential viewers.

He was presented with his prize by ConstructionSkills Chief Executive Mark Farrar at a ceremony in central London. Mark Farrar, Chief Executive of ConstructionSkills, commented: "Christopher is a fine example of the sort of talent we have on our Inspire Scholarship Scheme. By putting companies in touch with the cream of the undergraduate crop, we take the hassle out of recruitment and ensure these graduates can begin making a difference as soon as they leave university. Our Inspire scholars show just the sort of passion and energy we need in our industry, particularly as we emerge from recession and face new and unique challenges, such as the low carbon agenda."

To find out more about Inspire Scholarships visit: www.bconstructive.co.uk

Human language translation technology competition winners

An annual international competition to find the best Machine Translation systems has announced the 2009 winners.

الترجمة الآلية من العربية الى الانكليزية في جامعة كامبريدج

The Department's team was ranked the top Arabic-to-English translation system. The team was led by Dr Bill Byrne and Dr Adrià de Gispert and included Graeme Blackwood and Jamie Brunning from the Department and Gonzalo Iglesias from the University of Vigo, Spain. The system was placed first in both the Single System Track and the System Combination Track.

The competition, run by the US

National Institute of Standards (NIST), is part of an ongoing series of evaluations of human language translation technology. NIST defines a set of translation tasks and a set of common resources so that systems can be directly compared to each other. The Cambridge system was based on a hierarchical phrase-based decoder implemented with weighted finite state transducers. The system also performed

multiple morphological analyses of Arabic text to improve translation of 'noisy' text, such as web pages and blogs. The competition is a showcase for postgraduate research in the Department and is closely watched by industry and academic researchers worldwide.

NIST MT09: www.itl.nist.gov/iad/mig/tests/mt/2009/ResultsRelease

Graduate Nicholas Patrick, astronaut, on his second mission into space

Earlier this year in Florida the shuttle launch of the spaceship Endeavour took place. Endeavour's Space Shuttle Mission: STS-130 delivered two European-built modules to the International Space Station (ISS). Alumnus Nicholas Patrick was on board with a leading role in the 13-day venture.



Nicholas spent a weekend with the rest of the Endeavour crew at the Kennedy Space Center, sleeping odd hours to time-shift his internal clock so that he would be wide awake during the hours in which he made three spacewalks.

During the spacewalks known as EVAs (Extra-Vehicular Activity), he helped plug in the new connecting Node 3, also known as Tranquility, which will provide additional room for crew members and many of the space station's life support and environmental control systems. Attached to the node is a cupola, which is a robotic control station with six windows around its sides and another in the centre that provides a panoramic view of Earth, celestial objects and visiting spacecraft. This is Nicholas's second mission to date. His first was in 2006 when shuttle astronauts fitted a backbone segment to the ISS.

Nicholas's duties this time were much more centre-stage. While a robot arm is used to unload modules from a visiting shuttle and position them on the station, it

is the spacewalkers who must plug in all the "services" – the electrical, cooling and communications lines.

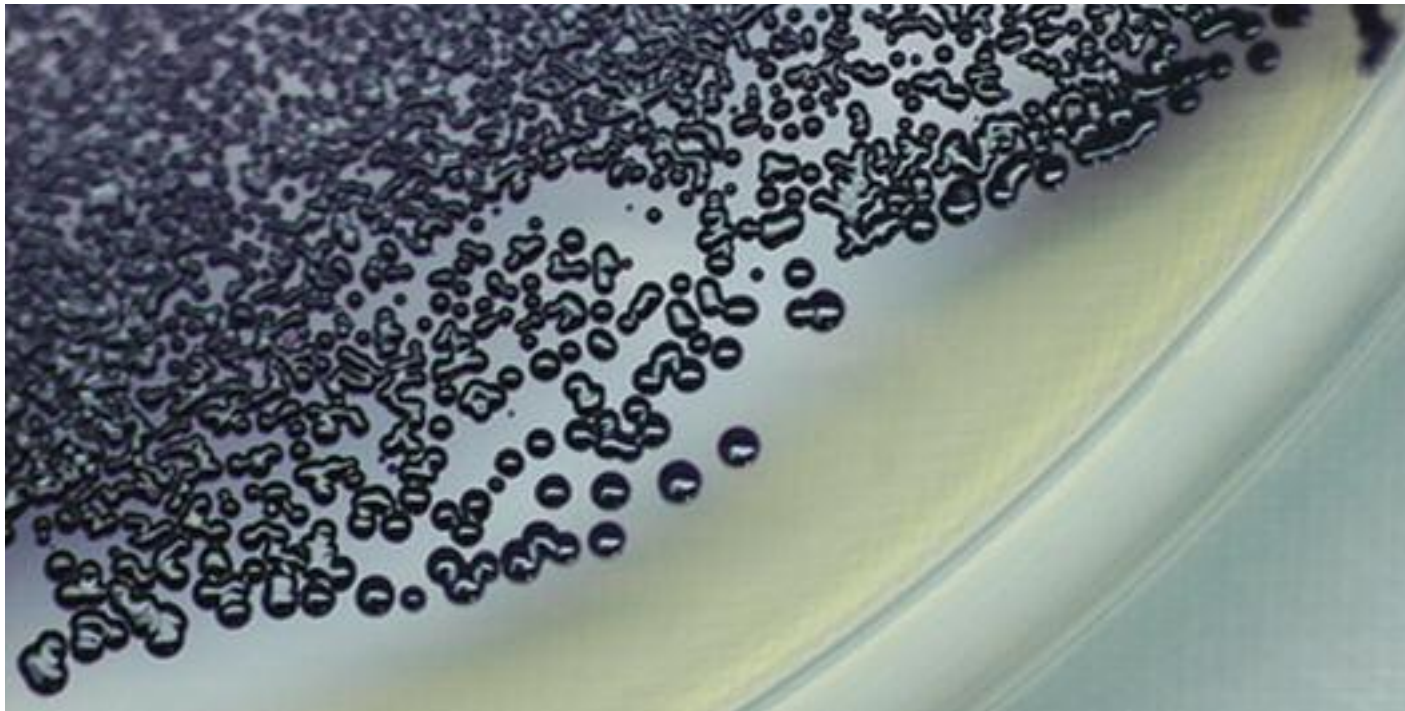
The EVAs are gruelling affairs that start long before the astronauts step out of the airlock. The night before the spacewalks, Nicholas and his co-walker Robert Behnken camped out in the airlock. The practice is used to purge nitrogen from their bodies and prevent decompression sickness, also known as "the bends". Once outside, it is an extremely full day's work, seven or more hours without a break.

Nicholas says his goal after this mission is to try to get selected for a long-duration mission on the space station. With the shuttle due to stop flying at the end of the year, the opportunities to go into orbit will be drastically reduced.

From 2011 onwards, for a few years at least, the only way into space for humans will be on board Russian Soyuz rockets, and they only seat three individuals compared with the shuttle's seven.

The Cambridge 2009 iGEM team awarded the Grand Prize

The Cambridge 2009 iGEM team was awarded the Grand Prize at the iGEM2009 Synthetic Biology competition finals at the Massachusetts Institute of Technology (MIT).



This was against stiff competition from over 100 teams in top international institutions. The team, which included two engineering students, Mike Davies and Alan Walbridge, provided a superb description of their work engineering DNA devices for transcriptional tuning and pigment production in environmental biosensors. As well as winning the overall prize for best project, the Cambridge team was awarded a gold medal and trophy for the best project in the Environment Track. iGEM is the International Genetically Engineered Machines competition, held annually at MIT. It is the central event for the field of Synthetic Biology. This year 112 teams from universities all over the world met in Cambridge, Massachusetts to compete against each other and show off their summer projects.

Synthetic biology is fundamentally about the union of biology and engineering, applying engineering principles to Biology. By modularising 'parts' and giving them all the same input and output type, different types of bacteria can be created from strings of DNA code. A standard modular biological part is called a BioBrick – a string of DNA that has a particular start and finish sequence, which allows them to be easily joined together. When two BioBricks are joined together, you end up with a new,

bigger BioBrick. The field promises to make devices to produce fuel or animal food from waste; make devices to soak up carbon from the atmosphere and lock it away; synthesise plastics without using oil; create devices to sense pollutants; and create new drugs.

The Cambridge 2009 iGEM team has created two kits of parts that will facilitate the design and construction of biosensors in the future. The team successfully characterised a set of transcriptional systems for calibrated output (Sensitivity Tuners) and expressed a spectrum of pigments in *E. coli*, designing a set of Colour Generators. They were creating a system for detecting the concentration of a specified input chemical, which, depending on the concentration of the input, would produce a different colour pigment output.

Though *E. coli* does not naturally produce any pigment, several other bacterial species secrete pigmented antibiotics. The team mined bacterial genomes for pigment-producing operons, and transformed the most prominent candidates into *E. coli*. In particular, the team devoted their summer to three different pigment systems: Carotenoids (Red/Orange/Yellow), Melanin (Brown/Black) and Violacein (Purple/Green). Mike Davies had the following to say

about the iGEM experience, "Both myself and Alan got involved with iGEM through the Undergraduate Research Opportunities Programme (UROP) scheme. I would certainly recommend other undergraduates to take full advantage of the UROPs, as the choice of work you can do is vast and it is a fantastic insight into what research is really like. I'd like to use this opportunity to thank Alexandre Kabla, Jorge Goncalves and Daniel Wolpert for their support with the Department's UROPs. Keith Glover and Ian White have also been helping with the recruitment of Engineers for iGEM and many other UROPs."

For further information visit:
<http://2009.igem.org/Team:Cambridge>



*The Cambridge 2009 iGEM team
Engineering students Alan Walbridge 3rd
from left top row, Mike Davies middle
bottom row*

CamSemi win Carbon Trust Innovation Award

CamSemi, a spin-out company from the Department of Engineering, has been awarded the 2009 Carbon Trust Innovation Award in recognition of the company's innovative power management integrated circuits (ICs) and their potential to cut the energy consumed within buildings.

CamSemi was scrutinised by a panel of independent experts from government, science and business and was awarded the prize for genuine innovation, carbon-saving potential and commercial opportunity. This award comes just months after the company was awarded 'University Spin-out of the year' in the New Energy Awards 2009. It was also previously named Start-up of the Year 2008 by the National Microelectronics Institute and was short-listed for two Business Weekly awards in 2008.

Founded by Professor Gehan Amaratunga and Professor Florin Udrea in 2002, CamSemi designs bespoke chips to control power devices found throughout our homes, many of which waste over half the energy they consume in heat.

One device they launched in 2007 now sits in power supplies that are 86% efficient and are sold with routers, modems and cordless phones. The company's latest device controls the world's first mobile-phone charger that meets new standards for ultra-low power consumption.

Dick Strawbridge, a television presenter, eco-engineer and one of the judges of the award, said: 'I love the CamSemi solution. In the 1780s Edmund Burke said no one



CamSemi's C2160 PSS controllers significantly cut the no-load power consumption for mobile phone chargers and other products.



Professor Gehan Amaratunga, CTO and founder of CamSemi

could make a greater mistake than he who did nothing because he could only do a little. CamSemi is a classic example of a company that has done a little that will add up to a lot.'



Professor Florin Udrea, Fellow and founder of CamSemi

The Carbon Trust Innovation Awards was founded in 2003 to recognise 'cleantech champion' and success stories from the UK's rapidly growing low carbon economy.

James Buckley wins The Duke of York's Award for Creative Use of Electronics

First year Engineering student James Buckley has received the prestigious Duke of York's Award for Creative Use of Electronics, with £1000 prize money.

He also won The Intel International Science and Engineering Fair entry of £250 plus a trip to San Jose, California for the event. He was also Highly Commended for the Young Engineer for Britain award for which he received £150 prize money.

James describes his prize-winning system, which he designed and made whilst at King Edward's School, Birmingham: "I

designed a system to allow Duke of Edinburgh expedition leaders to keep track of walking groups through the hills and mountains without them having to arrange meeting points. Traditionally, Duke of Edinburgh leaders arrange meeting points along the route each walking group is following, to ensure they are not lost and are making progress. This works fine until a



group actually gets lost, at which point the leader then has to juggle finding the lost group with still meeting the others

repeatedly. This generates large amounts of stress on the leader. My idea came about due to first hand experience.

"How the project works: each walking group is given a transmitter to put in a backpack; each transmitter contains a GPS receiver along with a 2.4GHz radio transceiver. The Duke of Edinburgh instructor has a 'receiver' which again contains a GPS receiver but also a colour display. On the display each walking group will show up as a red dot (imagine a radar style display) with their position, walking direction, velocity, and positional accuracy plotted on the display. The system allows multiple transmitters (at least 20) to be used (each one just shows up as an extra dot). Communication between the devices is done by 2.4GHz radio. The current devices range is only 1.5 km. With a simple component replacement however, this can be converted to 15 miles (which would make the device much more useable). One advantage is that all the devices relay information between each other. If one group is out of range of the instructor, there is another group between them both. The position information from the out-of-range-group will be relayed through the in-range-group, still allowing the receiver to plot the position (commonly called 'mesh networking').

"The main difficulty encountered was physically manufacturing the device. A requirement of the A2 Design Technology course was that the project had to be made 'in-house'. Because my project was so complicated, we did not have the tools in school to make high quality, multilayer, PCBs. This meant I had to come up with my own fabrication methods for most of the manufacturing stages.

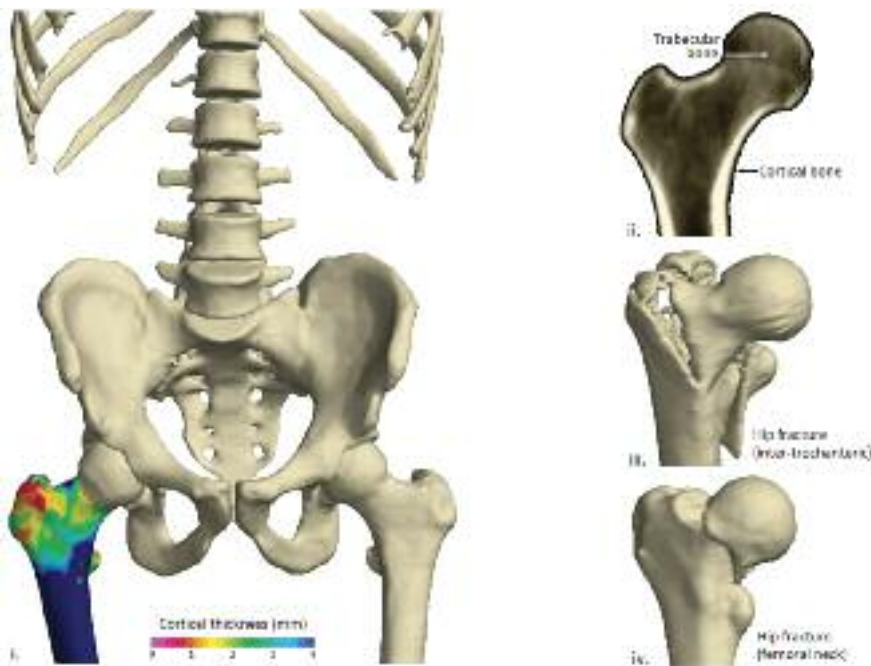
"All parts of the project were designed by me (electronics, software, and case). The case was manufactured using a 3D printer which another school allowed me to use."

Professor Mohammad Dastbaz, The Dean of the School of Computing and Information Technology from the University of East London presented the prestigious Duke of York Rose Bowl award. As part of his prize James will get the opportunity to visit Buckingham Palace for the official presentation from the Duke of York later this year.

These awards were part of the 'National Science and Engineering Competition' hosted at 'The Big Bang Fair' which features compelling and exciting shows, workshops, presentations and displays that cover the entire spectrum of science, technology, engineering and mathematics. Lord Mandelson presented a number of awards and gave a short speech where he praised the young talented entrants, saying they were very important for the future of the country.

Engineering in Medicine

Sometimes, things come together and make a real difference. Such a case in point is our work on Engineering and Medicine.



Visualising the thickness of the outer (cortical) layer of bone in the femur. i.) a cortical thickness map of a healthy adult male femur, with thick (blue/green) cortex at sites of high load during walking, ii.) cortical and trabecular bone. Typical fractures in the iii.) inter-trochanteric and iv.) femoral neck regions.

A few years ago we started fundraising to appoint a Lecturer dedicated to the crucial work of linking engineering research to clinical need. Unknown to us at the time, Dr Denys Armstrong, an engineering graduate and, later, an academic at Cambridge, bequeathed in his will a proportion of his estate 'to encourage the application of engineering in medicine'.

Whilst we were completing the funding to appoint the first Evelyn Trust Lecturer in Engineering for Clinical Practice, the bequest from Dr Armstrong came through, strengthening significantly this important initiative at its very outset. The final sum from the bequest amounted to GBP 1.7 million. This will enable us to finance research students whose work will complement the activities of the new Lectureship. The first student, who started this October, will be researching innovative medical imaging techniques to help identify those at risk of hip fracture. With annual fracture rates predicted to exceed six million by 2050, this is work of considerable scientific, social and economic importance.

Graham Treece, the first Evelyn Trust Lecturer in Engineering for Clinical Practice, says: "Philanthropy funded my post here at the Department so I have experienced at first hand just what an incredible difference donations and bequests can make. Collaborations between engineering and medicine can be very fruitful, but such

translational research only really happens if there are good lines of communication between researchers in both arenas. Recent research into the application of engineering techniques to medical imaging for osteoporosis is a highly promising example, which has further benefited from the award of an Armstrong studentship."

This gift demonstrates Dr Armstrong's understanding of the powerful impact that Cambridge can have in translating pure research into life-saving inventions and discoveries. Philip Guildford, Director of Research in the Engineering Department says: "This bequest came at a particularly opportune time as we had just funded a post through the Evelyn Trust and a private donor specifically to strengthen links between Engineering and the Clinical School. With the increasing demands placed on the healthcare sector, bringing engineering solutions to medical problems will have a hugely positive impact on all of our lives."

Denys Armstrong was able to make an extraordinary gift through his will. If you would like information about leaving money to Engineering, you will find details on the website: www.alumni.cam.ac.uk/campaign/guide/how/ or alternatively, contact the University Development Office, 01223 332288.

Laing O'Rourke Centre for Construction Engineering and Technology

Laing O'Rourke and The University of Cambridge have announced the creation of a new multi-disciplinary academic centre of excellence to advance the engineering profession and leverage innovative thinking to benefit the construction industry.

The UK's largest privately-owned engineering enterprise, Laing O'Rourke, is funding the Laing O'Rourke Centre for Construction Engineering and Technology at Cambridge as part of their multi-million pound collaboration with the University.

An agreement signed by Cambridge Vice-Chancellor Professor Dame Alison Richard, and Laing O'Rourke Chairman and Chief Executive Ray O'Rourke formally launched the new centre, which is set to play a leading role in shaping the future of the construction industry by responding to the environmental and sustainability challenges facing the planet.

The Centre will be a focus for innovative research and teaching, using the insights to help shape the built environment of the future in order to give as many people as possible access to the benefits of sustainable construction.

A new two-year part-time Masters degree in Construction Engineering will be launched in September 2011 by the Centre in the Department of Engineering, working with Judge Business School.

This course aims to advance the development of the construction sector through the translation of intellectual achievement into practical outcomes. It will produce engineers and managers who will lead the process of breaking down the traditional barriers between construction, consulting engineering and the client, pushing forward an agenda of innovation and technological advancement.

It will encompass the full spectrum of the industry value chain from the high-level financing requirements of major projects through to the latest innovations in analysis, design and materials technology, with a focus on sustainability and whole-life performance. The programme will be multidisciplinary aiming to embrace a broad range of sectors such as housing, buildings, transport, energy, water and waste.

The Centre, led by the new Laing O'Rourke Professor of Construction Engineering, will also deliver undergraduate education, PhD and post-doctoral research and Executive Education. A key goal is to raise the profile of the construction industry across the UK, attracting more young people to consider careers in this field and fast-tracking them through to senior management positions.



Ray O'Rourke said: "I believe the engineering and construction profession has reached a critical crossroads in its development – it has for too long relied on traditional skills and approaches, often failing to keep pace with the political, social and economic demands of modern society. It must once again attract the very best talent, apply radical thinking, embrace new technologies and innovate in a way that removes waste and inefficiency and creates the greatest value for the world's communities.

"Today's announcement is tangible evidence of the role Laing O'Rourke is committed to playing in this regard, and we are excited by the prospect of sharing our vision and forging an enduring relationship with Cambridge University, in line with our other educational partnerships."

Professor Dame Ann Dowling, Head of the Department of Engineering said: "The department's aim is to address the world's most pressing challenges through our teaching and research. I am excited by the potential of this new centre to develop novel solutions to the challenges of constructing a built environment that is sustainable whilst providing for the needs of society to supply energy, water, shelter, and a transport infrastructure on which economic well-being depends. I am grateful to Laing O'Rourke for their commitment and to Ray O'Rourke for his vision."

The Centre's inaugural Laing O'Rourke Distinguished Lecture will take place at the

Department of Engineering on 25 November 2010. The speaker will be Bill Baker, the Structural Engineering Partner for Skidmore, Owings & Merrill, LLP. Throughout his distinguished career, Bill has dedicated himself to structural innovation. His best known contribution has been to develop the "buttressed core" structural system for the Burj Khalifa, the world's tallest structure.

The Laing O'Rourke Centre for Construction Engineering and Technology: www.construction.cam.ac.uk



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