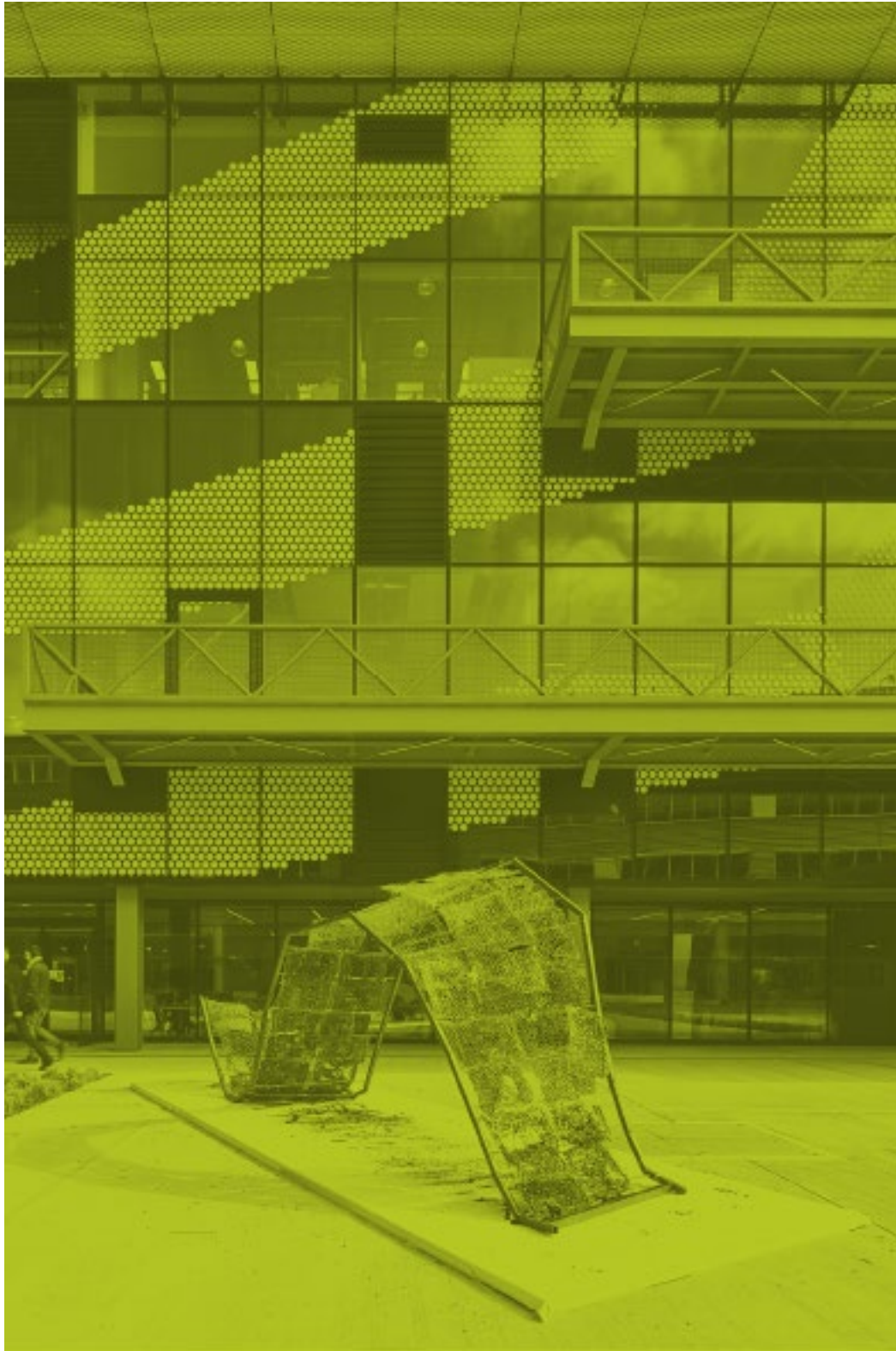




55 years of Environmental Design and Engineering at The Bartlett





UCL Institute for Environmental Design and Engineering 2020/2021 Review

UCL Institute for Environmental Design and Engineering (IEDE) pursues a deeper understanding of the interactions between the built environment and health, human wellbeing, productivity, energy use and climate change. We are part of The Bartlett: UCL's global faculty of the built environment.

UCL IEDE is a world-leading centre of research and teaching excellence and has received a series of awards, grants and accolades to confirm this. We are interested in making our buildings, towns and cities better places in which to live.

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> ucl.ac.uk/environmental-design

> @UCL_IEDE

Director's Report

Let's Build A Better Future Together

2020 is a year for reflection. The start of a new decade and the end of the Bartlett's centenary celebrations which signals a new chapter with great possibilities. With it also being the Institute's year when we mark 55 years of environmental design and engineering at the Bartlett, it is an opportune time to take stock of how far we have come.

Since Professor Sir Richard Llewelyn Davies appointed Ralph Hopkinson as the first Chair of Environmental Design and Engineering in 1965, we have enlarged the scope of architectural and engineering education to incorporate environmental and human factors. Our postgraduate courses in Environmental Design and Engineering (1978) and Light & Lighting (1987), are two of the oldest and most respected courses in the UK and globally.

Today, the UCL Institute for Environmental Design and Engineering, pursues a deeper understanding of the interactions between the built environment and health, human wellbeing, productivity, energy use and climate change. Currently, we host almost 100 Lecturers, Teaching Fellows, Research Associates and Doctoral Researchers. The Institute is home to 150 students on four postgraduate MSc programmes, and 120 students (steady state 240) on our newly established undergraduate MEng programme in Engineering and Architectural Design. Our research portfolio exceeds £12 million (23 projects) and we publish 5 peer reviewed journal and conference papers per academic per year on average.

The Institute is also a home to three

consecutive EPSRC Platform Grants awarded to "world leading research groups", and we are one of four Royal Academy of Engineering's Centre of Excellence in Sustainable Building Design. The Institute is part of the Bartlett's research-intensive School of Environment, Energy and Resources (BSEER) which also facilitates our sister Institutes (Energy Institute, Institute for Sustainable Heritage, and Institute for Sustainable Resources) by providing strategic leadership, and helps us establish ourselves to grow, enabling us to focus on and develop academic direction and strategies.

In the past few years, the Institute has increased its research and teaching activities in three key areas: climate change, health & wellbeing, and architectural engineering education. This is part of our aim to establish the Institute as a world-leading centre for human centric built environment research and innovation. This also enables the pioneering of professionally accredited teaching programmes.

Climate Change Resilience & Adaptation

Adapting our buildings and cities to a changing climate is a core cross cutting IEDE research theme, with particular focus on the protection of the most vulnerable segments of the population, such as children and the elderly. We have also helped set the standard for safer, cheaper, more energy efficient street lights, and we are building a community to radically rethink building design, construction and operation.

Health & Wellbeing

We have helped demonstrate the link between planetary health, human health, and cities. We are part of a four-year project investigating the systems that connect urban development and health (Complex Urban Systems for Sustainability and Health, CUSSH) and in 2017, we launched an MSc in Health, Wellbeing and Sustainable Buildings to create a new generation of socially sensitive urban and building practitioners. We are also going beyond the decibel scale, to try to measure noise in terms of human wellbeing (ERC Soundscapes Indices, SSID).

Architectural Engineering Education

We have opened new cutting-edge facilities in East London and launched new courses responding to the impact of climate change on the built environment. This includes our new MSc in Smart Buildings and Digital Engineering (2018), and integrated Engineering and Architectural Design MEng for undergraduates (2017) – a pioneering collaboration with the Bartlett School of Architecture and UCL's Department of Civil Environmental and Geomatic Engineering.

The Institute's new strategy calls for research and teaching temporal integration across the spatial scale: from Urban to Building to Human. In the last few years, we have won large grants focusing on research integration across the scale: CUSHH, SSID and CAMELLIA, and we would like to build on our success by creating a critical mass of researchers in this field. As part

of our new strategy, we have appointed Dr Clare Heaviside from April 2020 as an Independent NERC Fellow with a Proleptic Associate Professorship to follow in 2023. Clare was Head of Climate Change and Health Research at Public Health England working on climate change, health, air pollution and urban climate.

This annual review outlines our 55 years long history at the Bartlett, current research projects, a portfolio of our teaching programmes as well as our plans moving forward.

Let's Build A Better Future Together.

**Dejan Mumovic MEng MSc PhD
CEng FCIBSE FIBPSA MASHRAE**

**Professor of Building Performance
Analysis**

**Director of the UCL Institute
for Environmental Design and
Engineering**

IEDE In Numbers:

1st in the UK for research strength in Architecture and the Built Environment (REF 2014)

1st in the UK and 3rd in the world for Architecture and the Built Environment (QS 2020)

3 platform Grants awarded by EPSRC

1 of only 4 UK Royal Academy of Engineering Centres of Excellence in Sustainable Building Design

55 years of Environmental Design and Engineering at The Bartlett

In 2020 we mark 55 years of Environmental Design and Engineering in The Bartlett.

The story starts back in 1960 with Professor Richard Llewelyn Davies introducing a wholesale restructuring of Architectural education at UCL. Before his appointment, students revolted against traditional Beaux Arts teaching leading to an investigation from RIBA. In his inaugural lecture Professor Llewelyn Davies advocated multidisciplinary training, bringing art and social sciences to architectural education. Multidisciplinary research and teaching remain the foundation upon which UCL IEDE's teaching and research is structured today.

And so began the introduction of Environmental Design and Engineering at The Bartlett. Prof Llewelyn Davies brought in Ralph Hopkinson as the first chair in Environmental Design and Engineering in 1965. With his appointment, Hopkinson enlarged the scope of architectural education to incorporate environmental and human factors.

During Ralph Hopkins' time at Bartlett Wates House opened, home to state-of-the-art environmental acoustic and lighting laboratories. Wates House has since transformed into The Bartlett's modern HQ, 22 Gordon street and we now boast one of the most sophisticated Lighting Simulators in the UK, based at Here East in the Olympic Park. Alongside the simulator we have a 24m² environmental chamber, two

full weather stations, data loggers capable of recording temperature relative humidity, illuminance and further sensor inputs such as CO₂ levels, and much more.

And so expanded Environmental Design and Engineering at the Bartlett, with a dedicated Masters launched in 1978, shortly followed by an MSc in Light and Lighting launched in 1987. Since the dedicated UCL Institute for Environmental Design and Engineering was established we have launched complimentary Master's in Health Wellbeing and Sustainable Buildings and Smart Buildings and Digital Engineering. Our PhD programme offers students a research environment of the highest standard, allowing them to engage with complex real-world design, engineering and policy projects and issues.

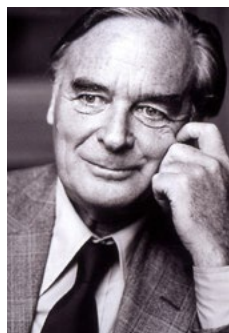
Having established the Institute as the Established centre for Environmental Design and Engineering at The Bartlett we have since moved from strength to strength. The Institute was named by the Royal Academy of Engineering as a Centre of Excellence in Sustainable Building Design. We have won an unprecedented three platform grants. Our dedicated team of around 50 academics and researchers continue to innovate in environmental design and engineering, taking on the complex issues of health, productivity, climate change and energy use in the built environment.



1960

Richard Llewelyn-Davies joins The Bartlett

Following the 1958 Bartlett student revolt against their traditionalist Beaux Arts teaching Prof. Richard Llewelyn Davies was appointed as Head of School in 1960. He sought to radically change architectural study, bringing together science and art and advocating a multidisciplinary training regime, a pillar upon which our postgraduate study at UCL IEDE rests today.



1975

Wates House opens, housing state of the art EDE equipment

A physical manifestation The Bartlett's new direction, Wates House opened. New state-of-the-art acoustic and lighting laboratories were home in the building including a wind tunnel, thermal chamber and artificial sky.

1965

Ralph Hopkinson is appointed as first Chair in Environmental Design and Engineering

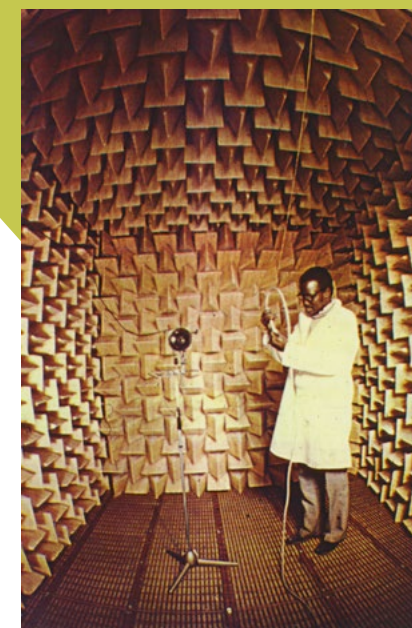
This signified the school's movement from the Beaux Arts tradition to a broader conception of architectural study that incorporated environmental and human factors, training a future generation of architects and building engineers to deal with increasingly complex building systems and social demands.



1978

MSc in Environmental Design and Engineering launched

The appointment of John Musgrove as Professor of Environmental Design and Engineering saw the introduction of a cross-disciplinary programme aimed at training a new generation of professionals to bridge the gap between the high-quality research being conducted into building performance, and the actual design and construction of buildings being erected at the time.



1967

Richard Llewelyn-Davies' planning practise works on the design of Milton Keynes



1969

Ralph Hopkinson receives RIBA Honorary Fellowship for establishing lighting as a core architectural skill



1987

MSc in Light and Lighting launched

1989

Pat O'Sullivan is appointed as Haden-Pilkington Professor of EDE and Head of School at The Bartlett School of Architecture, Building, Environmental Design and Planning

1992

The Bartlett School of Graduate Studies is founded

The Bartlett School of Graduate Studies was home to Environmental Design and Engineering, and Light and Lighting programmes, among others. When it was dissolved 22 years later, the School had graduated more than 6,000 Master's degrees and nearly 300 PhDs during its lifetime.

MSc in Facility and Environment Management launched



2001

EDE Alumna May Cassar establishes the Centre for Sustainable Heritage

The centre sought to bring innovative and interdisciplinary approaches to the study of heritage, from buildings, collections and sites to oral histories and memories. The centre became UCL Institute for Sustainable Heritage in 2014 and joins IEDE in The Bartlett School of Environment, Energy and Resources

2006

First EPSRC Platform Grant awarded for Complex Built Environment Systems project

Established a multidisciplinary Complex Built Environment Systems group from 2006-2011 to research three main objectives: ¹ How to design, maintain and operate the built environment while minimising the emissions of greenhouse gases ² How to adapt the environment, fabric and services of existing and new buildings to climate change ³ How to improve the environment in and around buildings to provide better health, comfort, security and productivity.

2009

Alumnus Tadj Oreszczyn establishes UCL Energy Institute

The UCL Energy Institute delivers world-leading learning, research and policy support on the challenges of climate change and energy security.



2011

Second EPSRC Platform Grant awarded for The Unintended Consequences of Decarbonising the Built Environment

This established a strategic programme of research to transform the understanding of the system-level effects of climate change policies alongside sister Institutes at The Bartlett School of Environment, Energy and Resources between 2011-2016.

2013

EDE was named by the Royal Academy of Engineering as a Centre of Excellence in Sustainable Building Design



2014

The UCL Institute for Environmental Design and Engineering is established

2017

Historic third EPSRC Platform Grant for 'Built Environment Systems Thinking'

No other group has ever received three before platform grants before. This third grant will develop a new strategic programme of research aimed at informing the scientific understanding of the systemic nature of a sustainable built environment.

MSc in Health Wellbeing and Sustainable Buildings and MEng Engineering and Architectural Design established

2018

IEDE expands to new research and teaching facilities in HereEast, Queen Elisabeth Olympic Park

MSc in Smart Buildings and Digital Engineering established



Teaching

- 13 Engineering and Architectural Design MEng
- 14 Environmental Design and Engineering MSc
- 15 Health, Wellbeing and Sustainable Buildings MSc
- 16 Smart Buildings and Digital Engineering MSc
- 17 Light and Lighting MSc
- 18 PhD



Engineering and Architectural Design MEng

We're challenging the most able undergraduate students to develop robust knowledge and experience of architectural, environmental and structural design and engineering in buildings.

About the programme

This programme has been designed in close collaboration with industry leaders to combine the major disciplines of architecture and engineering of the built environment and prepare graduates to be future leaders.

Placing creativity and design at the centre of engineering education, this interdisciplinary programme gives students the chance to understand and develop advanced design methodologies while becoming an expert in how they are augmented and resolved.

Our students enjoy unrivalled spaces to work in, including new facilities at Here East, Queen Elizabeth Olympic Park as well as centrally located departments in Bloomsbury.

The programme is run jointly with the Bartlett School of Architecture and the UCL Department of Civil, Environmental and Geomatic Engineering.

Accreditation

This programme has been fully accredited as suitable 'further learning' to meet the academic requirement for Chartered Engineers (CEng) by CIBSE. The programme is designed to meet Engineering Council MEng and Architecture degree-level requirements. We are actively seeking accreditation from the Joint Board of Moderators (JBM, which includes IStructE and ICE) and Architects Registration Board (RIBA/ARB) Part 1 exemption.



Key information

- > Programme lead - Dr Luke Olsen
- > Full time - four years

Environmental Design and Engineering MSc

The Environmental Design and Engineering MSc develops innovative thinking about sustainable building design, energy use and building-related health issues to use in leading international roles.

About the programme

The MSc develops students' knowledge and expertise in problem solving and critical thinking in the area of the built environment, and reflects the joined-up, interdisciplinary ways of working increasingly demanded by industry. It provides a rigorous framework for the development of innovative thinking in the design and operation of buildings, placing associated environmental issues in a human, national and global context.

The programme's unrivalled access to scientific and professional knowledge and experience provides students with the opportunity to be taught by global experts in their field, and be involved in groundbreaking research.

Graduates from the EDE MSc will join its global alumni – a long list of high-achieving professionals whose skills are in demand from the biggest names in design and construction, from Foster & Partners to Arup, Willmott Dickson to BRE.

Accreditation

This programme has been fully accredited as suitable 'further learning' to meet the academic requirement for Chartered Engineers (CEng) by CIBSE.



Key information

- > Programme lead - Dr Sung-Min Hong
- > Full time - one year
- > Flexible - two to five years

Health, Wellbeing and Sustainable Buildings MSc

Teaching a new generation of experts who can drive innovation for health and wellbeing in the design, assessment, retrofit and operation of sustainable buildings.

About the programme

This Master's responds to the demand for a new generation of experts to drive the health and wellbeing agenda in the built environment, working in ways that are sustainable and innovative. It builds on the explosion of global interest in sustainability, health and wellbeing in buildings, following the adoption of the wellbeing agenda by building designers and urban planners.

The convergence of the green and health and wellbeing agendas has led to the emergence of a more holistic, human-centred approach to design, and made health and wellbeing an increasingly influential part of IEDE's research portfolio. Research projects have so far included the impact of greenhouse gas reductions on public health; indoor air quality and overheating in homes and schools; and the health effects of moisture in buildings.

Students on the MSc are taught by leaders in the field and have opportunities to network with and learn from industry experts, developing their understanding of commercially applicable, research-oriented tools and approaches, and benefiting from opportunities for hands-on experience and exposure to real-world scenarios.

Key information

- > Programme lead - Dr Helen Pineo
- > Full time - one year
- > Part-time - two years
- > Flexible - two to five years



Accreditation

This programme has been fully accredited as suitable 'further learning' to meet the academic requirement for Chartered Engineers (CEng) by the Chartered Institute of Building Services Engineers (CIBSE). Content is mapped out against industry standards such as the WELL Building Standard, BREEAM and LEED.

Smart Buildings and Digital Engineering MSc

Delivering smarter buildings and a better built environment for the interconnected, sustainable world of tomorrow.

About the programme

Creating innovative designs requires advanced modelling and simulation skills, collection and interpretation of data, and solid core knowledge of energy engineering.

The Smart Buildings and Digital Engineering (SBDE) MSc programme, started in September 2018, offers exceptional university graduates the opportunity to become experts capable of delivering smart high-performance solutions utilising digital modelling technologies to the fullest extent.

The programme builds upon the strong expertise of IEDE in the areas of smart buildings, digital engineering and building services.

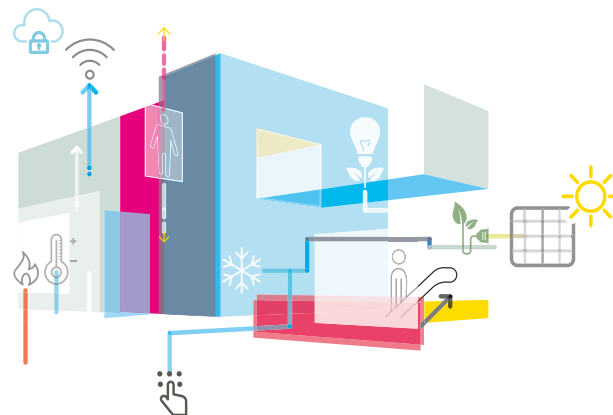
Strong links and collaboration with the industry in the context of research projects, has helped shape a contemporary and forward-looking programme of study.

Accreditation

This programme has been fully accredited as suitable 'further learning' to meet the academic requirement for Chartered Engineers (CEng) by CIBSE and the Energy Institute.

Key information

- > Programme lead - Dr Dimitrios Rovas
- > Full time - one year
- > Part-time - two years
- > Flexible - two to five years



Light and Lighting MSc

The Light and Lighting MSc is all about the human experience of the built environment, inside and out, and brings together the technical and creative sides of lighting design to enable you to shape sustainable lit environments.

About the programme

This Master's provides a holistic approach to lighting design considering the human response to light and lighting, science and technology, together with the design of lighting as an integrated component of architecture and the built environment.

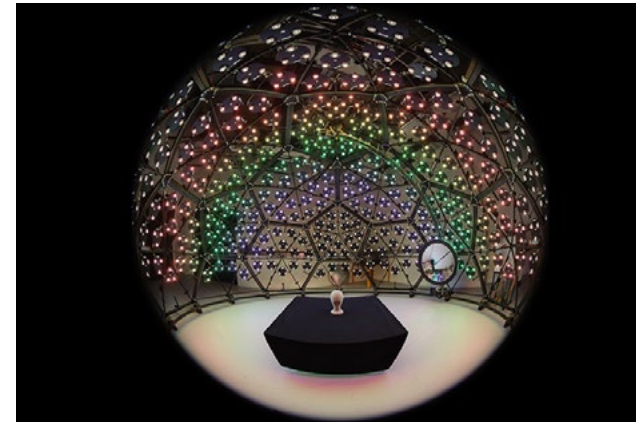
The design project briefs are set by industry, ensuring up-to-date engagement with practice. This provides an opportunity for students to apply their new found theoretical knowledge, which includes a wide scope of topics, ranging from daylighting, the impact of light on architectural form, to lamp and luminaire technologies.

Prestigious members of the London lighting community do guest lectures on the programme, and the design module is led by a practitioner. Our students have gone on to work for large engineering consultancies, independent lighting design practices, manufacturers and universities.

In summary, the programme provides an all-round approach to light and lighting so that graduates have both the vision to design beautiful lit environments and the skills necessary to ensure that they are successfully engineered.

Key information

- > Programme lead - Dr Jemima Unwin
- > Full time - one year
- > Part-time - two years
- > Flexible - two to five years



Accreditation

This programme has been fully accredited as suitable 'further learning' to meet the academic requirement for Chartered Engineers (CEng) by the Chartered Institute of Building Services Engineers (CIBSE).

PhD

Environmental Design and Engineering MPhil/PhD

Our PhD students engage with complex real-world design, engineering and policy questions and projects. Students collaborate with an extensive network of outstanding organisations in policy, industry, academia and NGOs.

Supervision and mentorship is available from world-leading and well-connected researchers. The programme offers the opportunity to collaborate with a wide range of academic disciplines, professional partners and to conduct research that has the potential to command an audience and an influence far beyond UCL, London and the UK.

Research themes

We deliver interdisciplinary built environment research to improve health, wellbeing and sustainability. We aim to understand how different elements interact to create buildings and spaces where people can live healthy, fulfilling lives that respect and care for the environment and resources.

Our main research areas are:

- Building Performance and Processes
- Energy Use in Buildings
- Building Stock Modelling
- Healthy Buildings
- Environmental Policy
- Environmental Performance
- Light and Lighting
- Facility Management
- Outdoor Environment
- Systems Thinking
- Workplace Innovation

Research partners

We work closely with leading bodies in academia, industry and policy to shape our research and teaching agenda.

Our postdoctoral researchers have benefitted from a range of support and sponsorship from bodies such as Skanska, Foster + Partners, BRE, CIBSE and more. Our research partners include members of the BauHow 5 alliance of leading schools of architecture and built environment in Europe, and the school of architecture and building science at Tsinghua University, Beijing.

Key information

- > Full time - three year
- > Part-time - five years

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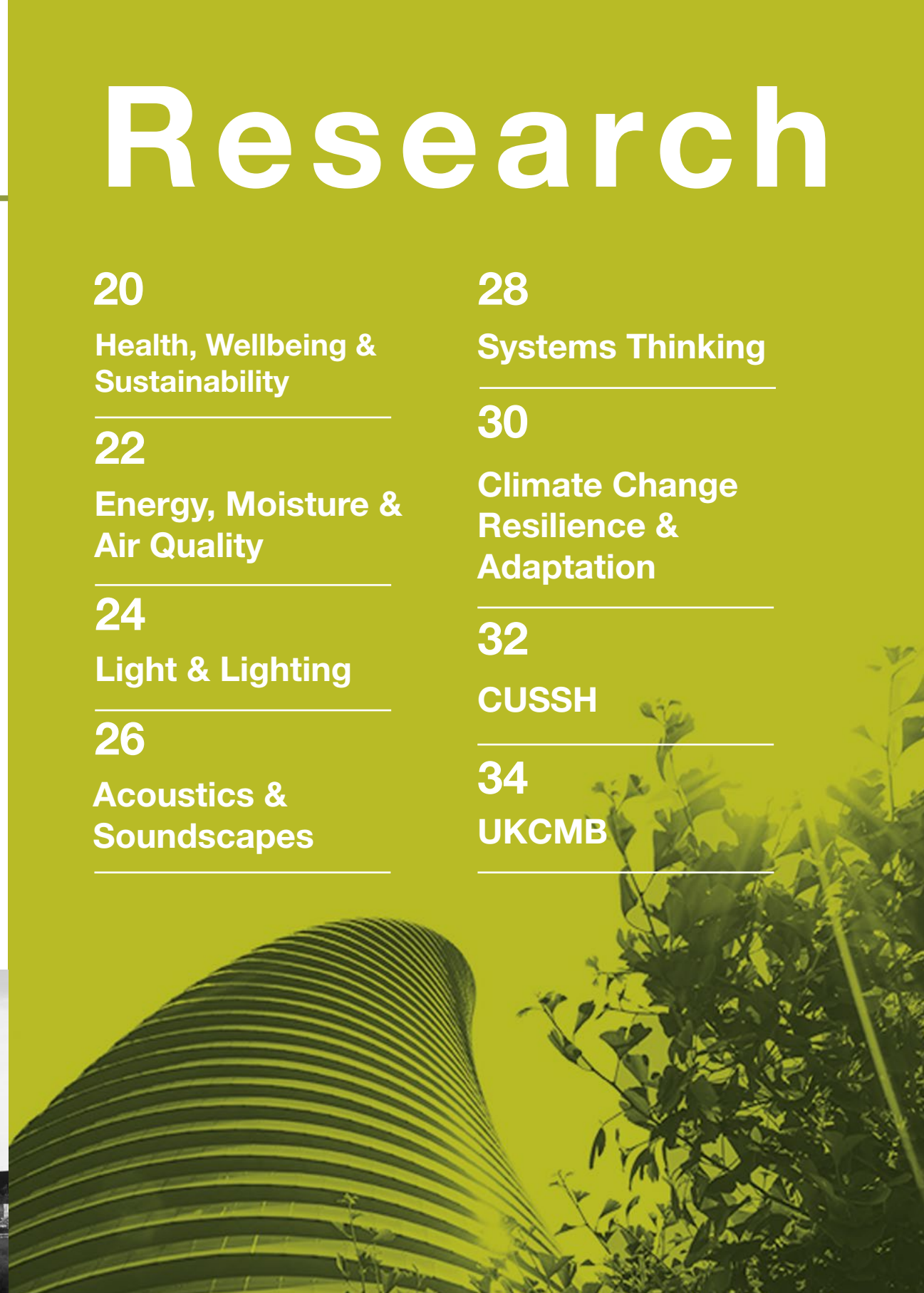
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Health, Wellbeing & Sustainability

Creating buildings and spaces that support human health and wellbeing and ensure the sustainability of local and global ecosystems is the core purpose of IEDE research.

What we do

We undertake specific research to understand the relationships between people, buildings and the environment.

This year we have continued our leadership of the Wellcome Trust funded Complex Urban Systems for Sustainability and Health (CUSSH) project, working with international partners and the Greater London Authority.

We facilitated a community co-design project to create a community garden that also improves water management in London, as part of the Community Water Management for a Liveable London (CAMELLIA) programme, funded by NERC.

Our work on healthy and sustainable schools and care homes continued with new projects awarded by NERC and the EPSRC.

Student dissertations and coursework on the MSc Health, Wellbeing and Sustainable Buildings provided strong integration with our teaching, building the next generation of researchers and professionals working with us towards a sustainable, healthy future.



Community garden co-design tackling water management

London's population is rapidly growing. With 50,000 new homes planned per year, new dwellings require both consistent water supply and a reduction in flooding risk. Water availability can dramatically change over a short space of time. In 2012, London saw dramatic springtime droughts followed by a summer of prolonged rainfall and localised flooding. Such extreme weather is only likely to worsen with climate change. As London's population increases and we face increasingly extreme weather changes sustainable water management systems are needed for London's burgeoning population.

Enter 'Community water management for a liveable London' (CAMELLIA). This project brings together environmental, engineering, urban planning and socio-economic experts with governmental and planning authorities, industry, developers and citizens to co-

develop solutions that will enable required housing growth in London whilst sustainably managing its water and environment.

This year, researchers from the CAMELLIA project worked with residents from the Kipling Estate to co-design a community garden. Whilst the garden serves to enrich the local community, features to reduce water demand in and improve drainage. Through a series of workshops, a garden was designed to fulfil resident's aspirations of a community space with beehives and shared planting beds whilst also creating wider benefits to London's water infrastructure and environment.

Whilst the design method and software tools from this project will soon be available from the CAMELLIA Portal, residents are now using the design to raise funds to build the garden.

Healthy Cities: Affordable housing and sustainable infrastructure

By 2030, nearly half of Kenyans will be living in cities. With half of Kenya's population aged under 18, many young people are moving to urban areas in search of jobs, opportunities and more choices. Kenya's growing urban population need sustainable, resilient, affordable housing and getting this right is key to Kenya's development.

In May 2019, Mike Davies and Blessing Mberu were invited to present the CUSSH project at the 'Healthy Cities: Affordable housing and sustainable infrastructure' symposium in Nairobi, Kenya. The symposium brought together more than 200 policymakers, leading researchers,

business and civil society delegates to explore the potential for new innovative collaboration on affordable housing and sustainable infrastructure.

Co-hosted by the UK and Kenyan governments, a major symposium output was joint statement from both countries announcing a commitment to continue working together on affordable housing and sustainable infrastructure research, policy and practice in Kenya. Find out more about CUSSH on page 32.

Energy, Moisture & Air Quality

Buildings are complex, dynamic, socio-technical systems seeking to provide solutions to a multitude of sometimes ill-defined and conflicting design issues. Through our research, we aim to improve the design, operation and environmental quality of buildings.

What we do

We provide timely, impartial information on design techniques and building technologies and develop novel engineering tools to help industry deliver sustainable buildings.

Our researchers are pioneering the development of integrated multi-variable built environment data frameworks.

Our building and building stock performance modelling and analysis involve developing a digital model that usefully represents a complex system. We use these digital models to predict, assess and analyse the dynamic and complex interactions that influence environmental performance. This informs policy-makers and supports decision making for building design and operation.

We also complete air quality and hygrothermal measuring, monitoring and testing research involving environmental

chambers, extensive field environmental monitoring, detailed building and social surveys, and interventions in people's homes and workplaces.

IEA-EBC Annex 68

Researchers at IEDE are involved in IEA-EBC Annex 68 addressing Indoor Air Quality Design and Control in Low Energy Residential Buildings.

To achieve nearly net zero energy use we need more efficient, optimised buildings. In some industrialised countries new buildings are already well insulated. This shifts the focus to limiting space heating energy consumption by reducing ventilation demand. Reducing the amount of fresh air can save energy but may increase the risk of poor indoor air quality therefore, it is very important to find a balance between energy efficiency and ventilation.

The project aims to provide a scientific basis for the design and operational strategies of buildings that have minimal energy consumption, and also maintain high standards regarding indoor environmental quality. It aims to collect and provide data about properties for transport, retention and

emission of chemical substances in new and recycled materials under the influence of heat and moisture transfer.

IEDE's team contributes to several subtasks of this project on modelling and monitoring of indoor air quality and energy performance of low energy residential buildings. A key output will be a guidebook on operational strategies for optimal energy performance and good indoor air quality in residential buildings.

The empirical evidence that supports UCL's contribution to this project primarily comes from TOP project, a collaborative research between UCL IEDE and Tsinghua University.

Quality of indoor air on sites matched with outdoor air quality datasets to improve wellbeing outcomes

There is increasing interest in the indoor air quality (IAQ) in our homes, schools, and workplaces as people spend nearly 90% of their time indoors.

The aim of the QUASIMODO research project is to develop a personalised early warning signal (EWS) to trigger self-management when indoor air quality deteriorates, and to explore the impact of commercially available home air purifiers and associated EWS on perceived indoor air quality and self-reported wellbeing of occupants. This research also aims to advance our understanding of time-activity

patterns for use in modelling protocols that include prediction of human exposure to pollution from indoor sources.

The QUASIMODO Early Warning Sign (EWS) is tested in combination with a connected Philips Air Purifier. The EWS is piloted in three cities in Europe: London, Helsinki and Eindhoven. UCL IEDE is involved in testing and evaluation of this system in collaboration with Public Health England. This project is supported by EIT Digital.

Light & Lighting

Our research is about the way people interact with the lit environment. We study a wide range of lighting applications from daylight in buildings to roads at night. We work closely with industry and the results of our work have been used to change lighting practice in industry.



Daylight

We are currently studying particular aspects of daylight.

We are working on new daylight metrics and have developed a new metric for daylight Mean Indirect Cubic Illuminance (MICI). We have published a paper describing the metric, its application and relationship to existing metric. We are now working through evidence that demonstrates that the new metric is better at predicting the human perception of daylight than previous metrics.

We're also studying the impact of daylight exposure on older people's sleep quality. Sleep quality was used as a marker for

circadian entrainment and it was expected that better daylight, during the summer months would improve sleep quality. However, after a detailed study of 32 subjects we found no significant change in sleep quality despite significantly different daylight exposure.

In the dark: measuring the role of light in traffic collisions

It is a long-held tenet of road lighting that good lighting can reduce collisions. However, it is very hard to identify how many collisions are caused by poor lighting, factors such as driver tiredness and traffic density also play a major role.

In order to focus on the effect solely of light, researchers have developed a number of strategies. One strategy is to look at the weeks either side of the clock change in both spring and autumn. By reviewing these specific times it is possible to study collisions that might take place in the dark one week and that would have been in the light another week. By using this approach changes in traffic density and tiredness are minimised. However, working out which collisions are in the dark and which are in the light is not as easy as many previous studies have assumed, diluting the quality of their results.

Researchers at IEDA have developed a new

method. By studying daylight availability (as measured by Public Health England) as a function of solar altitude they were able to confidently state then when the solar altitude was greater than 0° it was light and when it was less than -6° it was dark. They tested the method. Looking at data from clock change weeks in the road traffic collisions database they were able to identify collisions of interest by calculating their solar altitude. As a result, they found that there are 23% more collisions in the dark, and 32% more pedestrian injuries comparative to in lighter conditions at the same time.

This work has now been published and we are now reviewing the collisions more closely looking for patterns that may explain the causes of the incidents.

Acoustics & Soundscapes

Since being re-established in IEDE in 2018, the Acoustics and Soundscapes research theme has been working on rebuilding a network for acoustics and psychoacoustics across UCL.

What we do

The team's expertise covers computer simulation and measurements for room and environmental acoustics, auralization, characterization and design of urban soundscapes, noise mapping and urban sound planning, social and psychological aspects of sound perception, green and sustainable materials for acoustics-oriented applications.

Most of the research efforts are currently deployed for the Soundscape Indices (SSID), an ERC Advanced Grant funded by the European Union, which aims at providing new metrics (soundscape indices) to describe the acoustic quality of public spaces by taking into account human perception and complementing traditional decibel-based metrics. The team have established research collaborations with the Bartlett School of Architecture, the Ear Institute, the Birkbeck-UCL Centre for Neuroimaging (BUCNI) and beyond.

The theme is lead by Prof Jian Kang, with Dr Francesco Aletta and Dr Tin Oberman working alongside him as Research Associates/Assistants on the EU-funded Soundscape Indices (SSID) project. Professor Jian Kang, chairs the EU funded COST Network on Soundscape of European Cities and Landscapes, and

chairs the Technical Committee on Noise of the European Acoustics Association (EAA), and is Editor-in-Chief of Acoustics, an MDPI Journal. Professor Kang is also a member of the Working Group 54 of ISO/TC 43/SC 1 which has been formed with a remit of standardization for perceptual assessment of human sound preference (ISO 12913 series on soundscape).

Within the theme, four PhD students are developing their research topic within the SSID project: Mercede Erfanian, Magdalena Kachlicka, Matteo Lionello and Andrew Mitchell. Four more PhD students are working on different topics related to building, architectural and environmental acoustics: Mithuna Maran, Huan Tong, Chunyang Xu, and Tingting Yang.

Soundscape workshops

We collaborated to the organization of the UKAN Soundscape Workshop together with the Noise Abatement Society (NAS), which took place in London on June 25th, funded by the EPSRC UKAN Network. The workshop was the most attended soundscape-focused event in UK in the last ten years at least. It brought together 140+ practitioners, civil servants and academics to exchange ideas and propose solutions to overcome the conventional noise control engineering tools in the management of acoustic environments, in order to promote the more holistic soundscape approach.

Listening and ambisonics facility

We managed to secure funding via the Research Capital Investment Fund (RCIF) for the project "Multisensory data acquisition system for ecologically valid reproduction of built environment scenarios" – this will help us completing the construction of the listening and ambisonics facility being developed at the new UCL site at HereEast.



TOP project

We collaborated with the EPSRC-funded TOP Project being carried out at UCL IEDE. Within the case studies applications, we provided the expertise and equipment to monitor and address the (psycho) acoustic performance gap for school, office, hospital and residential buildings. The outcomes of this work will inform the Technical Memorandum 61 "Operational performance of non-domestic buildings and large apartment blocks" to be released by CIBSE.

Systems Thinking

IEDE aims to inform complex policy decisions via ‘systems thinking’, leading to better outcomes for sustainability, health and equity while reducing unintended harms.

What we do

We consider decision-making in an integrated way that involves collaborative learning by policy, community, research and industry representatives. Our systems thinking approach tackles grand challenges in an integrated way, focusing on non-linear and long-term effects.

To do this we must use different decision-making processes, and methods that successfully support these processes. Here, we combine system dynamics modelling, participatory system dynamics, qualitative research and systems engineering. We work collaboratively with stakeholders to co-create solutions that have better prospects of co-benefits and of being sustainably implemented. In addition, we started using systems thinking to not only deliver robust solutions, but also to better coordinate inter- and transdisciplinary work.

Research topics include:

- > Systems thinking methods such as system dynamics modelling
- > Indoor environments and human performance
- > Designing healthy and low-energy buildings

- > Sustainable and healthy cities
- > Green infrastructure
- > Urban water systems
- > Planetary health and the built environment
- > Participatory system dynamics
- > Organisational change
- > Inter- and transdisciplinary collaboration



Low carbon buildings in China and the UK

In 2019, we completed the TOP (Total Performance of Low Carbon Buildings in China and the UK) project, which combined a systems thinking approach and system dynamics modelling with building physics modelling. We established a framework for such an integration and applied it to case study buildings in the UK and China.

This work contributed to built environment research as well as to system dynamics project management modelling by operationalising project partner alignment.

The project found that energy and indoor environmental performance need

to be assessed jointly in order not to be compromised. It also found that performance targets increase project complexity, making information sharing an important factor to avoid unintended consequences and insufficient performance.

The early focus on building performance through a target can increase information available, alignment between supply chain organisations and building performance. Findings from the project also informed the CIBSE Technical Memorandum No. 61 on total building performance.

Community water management for a liveable London

The CAMELLIA (Community Water Management for a Liveable London) project is a five-year project which started in 2019. The aim of the CAMELLIA project is to bring together environmental, engineering, urban planning and socio-economic experts with governmental and planning authorities, industry, developers and citizens to co-develop solutions that will enable required housing growth in London whilst sustainably managing its water and environment.

In the early phase of the project, for example, we help residents manage water in their newly established community garden in a London social housing complex and work with

stakeholder groups to develop a shared vision for the long-term sustainability of the blue, green and built environment at the large Thamesmead area south-east of London.

In addition to using participatory system dynamics modelling to manage water, our team developed an integrated qualitative model showing the interdependencies between disciplines and work packages. We use it to manage the interdisciplinary nature of our project in an innovative way to know where collaboration is required, how one team's output becomes another team's input as well as to develop novel inter- and transdisciplinary methodologies.

Climate Change Resilience & Adaptation

The last few years have seen a dramatic shift in public interest in climate change impacts worldwide. It is widely recognised that climate change resilience should be placed at the forefront of built environment research as a matter of urgency. Adapting our buildings and cities to a changing climate is a core cross cutting IEDE research theme, with particular focus on the protection of the most vulnerable segments of the population.

What we do

The recently launched EPSRC funded project 'Advancing School Performance: Indoor environmental quality, Resilience and Educational outcomes' (ASPIRE) aims to address a key knowledge gap: Can school buildings achieve climate resilience and low carbon emissions whilst maintaining high indoor environmental quality that enhances learning and health?

We are creating a library of school building archetypes by analysing large scale UK school building stock databases to simulate the energy, thermal and indoor air quality performance of each archetype under low carbon building design and operational

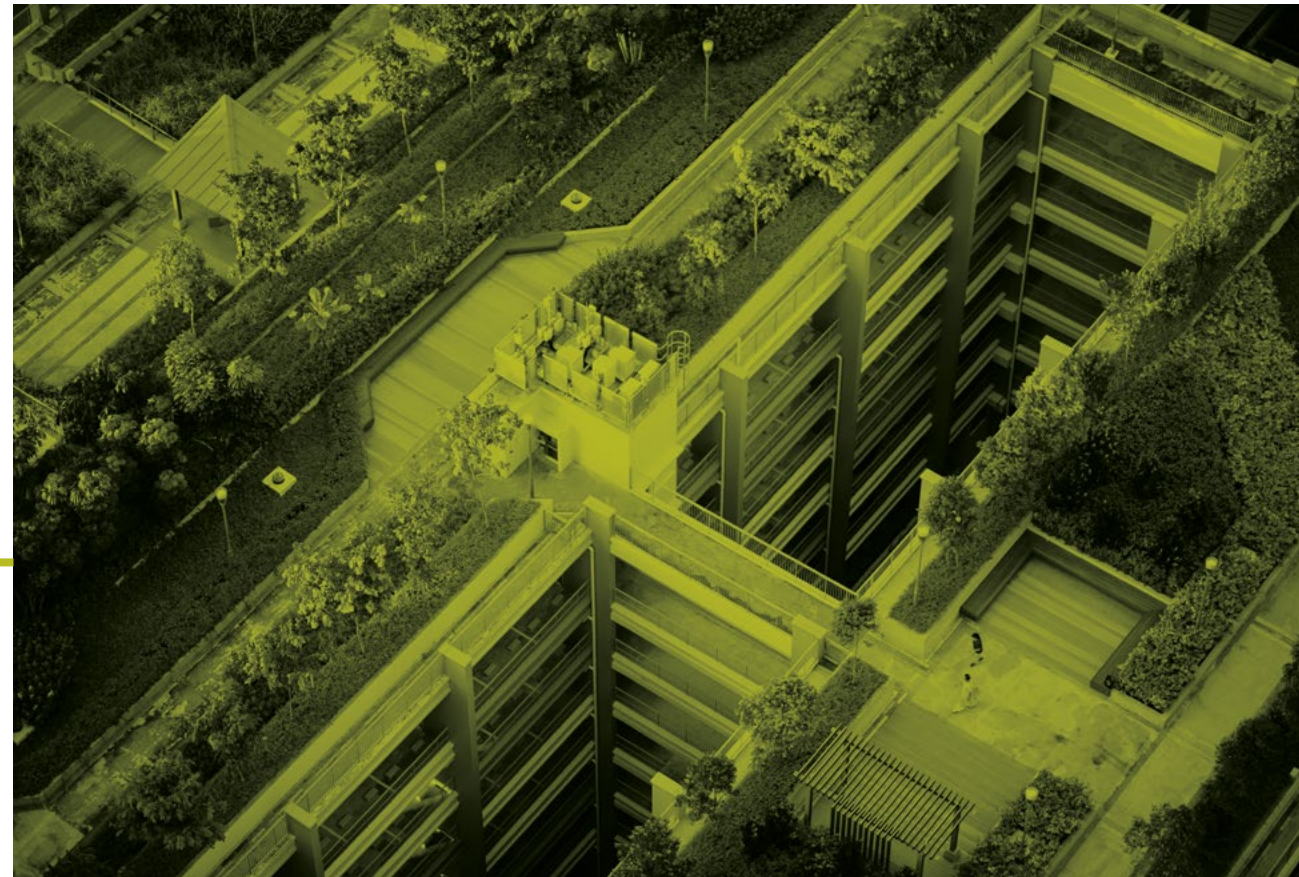
strategies in the current and future climate. These scenarios will be co-created as a result of two-way communication with stakeholders from the government, public health bodies, the construction industry and school communities.

At the urban scale, the new Wellcome Trust project 'Health and Economic Impacts of Reducing Overheating in Cities' (HEROIC) was funded under the Climate Change and Health theme. It will investigate the health and economic benefits of green infrastructure in various cities in terms of reducing heating and improving access to greenspace under a wide range of climate

change adaptation scenarios.

As part of the 'Climate Resilience of Care Settings' (ClimaCare) NERC project funded under the UK Climate Resilience Programme, we have developed methods that will support UK care provision in preparing for rising heat stress under climate change. This was achieved through monitoring of thermal conditions and surveys with residents, frontline care staff and care home managers in five London care settings. The project brought together

multidisciplinary research perspectives with those of care home practitioners and other stakeholders in order to develop a large scale project that will address the problems UK care providers face in a warming climate.



Complex Urban Systems for Sustainability and Health (CUSSH)

CUSSH is a four-year international research project. Started in 2018, it works with thirteen partner organisations across four continents to help cities develop in ways which improve population health and environmental sustainability. Based in six cities London (UK), Rennes (France), Kisumu and Nairobi (Kenya), and Beijing and Ningbo (China), CUSSH focuses on local priorities and city-scale actions aligned with planetary health.

Environmental and health challenges in Kisumu, Kenya

Local government and community engagement is at the heart of the CUSSH process. In 2019, the project made a successful application to Wellcome for an additional £250,000 specifically for work involving publics in co-creating and disseminating the project's research.

The major part of this work will be based in a number of informal settlements in Kisumu, Kenya. Kisumu faces multiple environmental and health challenges. Access to adequate sanitation in particular has remained unattainable for slum households, and the city faces a solid waste management crisis with impacts on the wider region. For example, contamination of neighbouring Lake Victoria has adverse effects on

water quality, reduction in fish stocks and consequent economic and nutritional losses for local communities.

A programme of engagement has been designed and is scheduled to start in early 2020. It will be facilitated by community engagement experts from Maseno University, in Kisumu County, guided by local groups of women and children from the informal settlements, and will involve the interaction of local businesses, NGOs, artists, film-makers, and local and national radio and newspaper journalists, with an additional aim of strengthening capacity for environment and health reporting in Kenya.



UKCMB

Many substantial building problems (including health problems) are caused by excessive or insufficient moisture. The UK Centre for Moisture in Buildings (UKCMB) has been set up to address these issues.

What we do

Inappropriate moisture levels in buildings are the cause of the majority of building failures including occupant health problems. Evidence indicates that such failures and problems may be changing and increasing in some areas due to factors such as increased airtightness and insulation, fuel poverty, overcrowding and changing use of buildings. However, there are many complexities and interactions, as well as uncertainty regarding the extent of the problem, its effects and causes.

The UKCMB was established with the mission to develop knowledge about the causes, mechanisms and solutions to moisture in buildings. We are independent, not for profit, public good organisation run by UCL, the Building Research Establishment (BRE), Heriot Watt University and the London School of Hygiene and Tropical Medicine.

The risks of not having a strong focus on moisture are considerable, with damage to building fabric and occupant health affecting our heritage, resources, natural environment and personal and social wellbeing.

The UKCMB brings together leading experts in the UK to provide an independent, authoritative, world-leading centre for research, education, guidance, training, innovation and policy-engagement.

Training and CPD

In November 2019 we ran our first

professional development course for building professionals to help understand moisture risks in buildings and how to manage them.

The course was based around the four principles set out in guidance from Neil May and Chris Sanders (BSI, London, 2018) and in the forthcoming new edition of BS 5250 Control of condensation in buildings. These principles, known as 'the four Cs', are:

- > Context: understanding the building's history, setting, construction, condition, occupancy pattern, etc.
- > Coherence: adopting a consistent, integrated, whole-building approach to all aspects of new-build and retrofit.
- > Caution: identifying, assessing and managing moisture risks, and, where knowledge is limited, erring on the side of caution.
- > Capacity: ensuring adequate capacity in building systems rather than over-optimising, to allow for unexpected or changing circumstances.

This is the first of many courses, with a new online training programme currently being developed.

Partnerships

UCL IEDE has a long track record of translating world-leading research into powerful competitive advantages for partners in industry, government and charity.

We work with companies of all sizes, as well as government departments and agencies, NGOs and small, focused charities. We tailor each partnership to fit precise needs, whether in the form of a Knowledge Transfer Partnership (KTP), an R&D Partnership, Research Engineers, consultancy or CPD training. Below are some examples of different partnership relationships we have recently engaged in.

Consultancy

IEDE has been working with Q-Bot to assess the impact of the first affordable and fully accredited remote solution for insulating suspended timber floors. Q-bot's robotic vehicles insulate the under-side of the floors in-situ, surveying the void and condition. If suitable, the robot sprays an expanding insulation foam and records the install to verify the area and depth of insulation applied.

Sponsored PhDs

IEDE is proud to be partnering with Hoare Lea to shape the next generation of engineers. Hoare Lea is an award-winning engineering consultancy with a creative team of engineers, designers, and technical specialists, providing innovative solutions

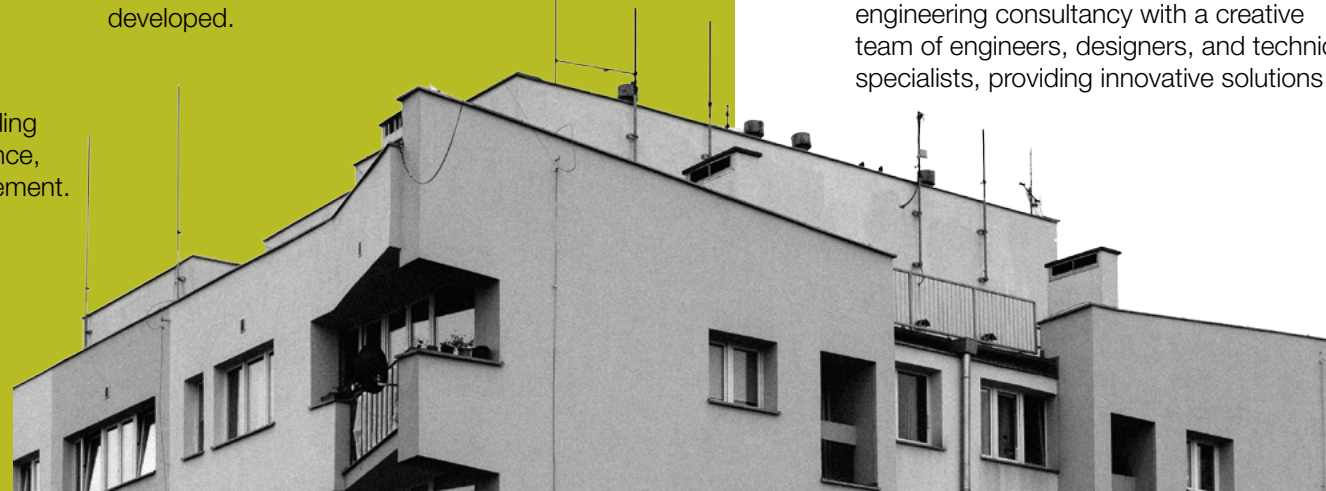
to complex engineering and design challenges.

Knowledge Transfer Projects

IEDE's collaboration with DesignBuilder to design a new energy model calibration software toolkit to create and apply accurate energy models of existing buildings based on combined design and measured data. Such models can be used for investigating performance gap issues, the effectiveness of energy saving measures and identifying the pathological behaviour of building systems.

Academic-Industry networks

UKCMB is an independent, not for profit, public good organisation run by UCL, the Building Research Establishment, Heriot Watt University and the London School of Hygiene and Tropical Medicine. UKCMB works rigorously and transparently with partners from academia, government, industry and the public to improve the way moisture risk is understood and managed in the UK.



Visiting Professors

We are building a community to radically rethink building design, construction and operation. Our Visiting Professors are helping us to establish the Institute as a world leading centre for human centric built environment research, innovation, and pioneering professionally accredited teaching programmes.



Ian Durbin CEng MCIBSE FConsE

Partner, Hoare Lea

Visiting Professor of Environmental Design and Engineering



Florence Lam MA (Cantab.) MSc CEng FIET FCIBSE FSL

Arup Fellow and Director of Ove Arup & Partners

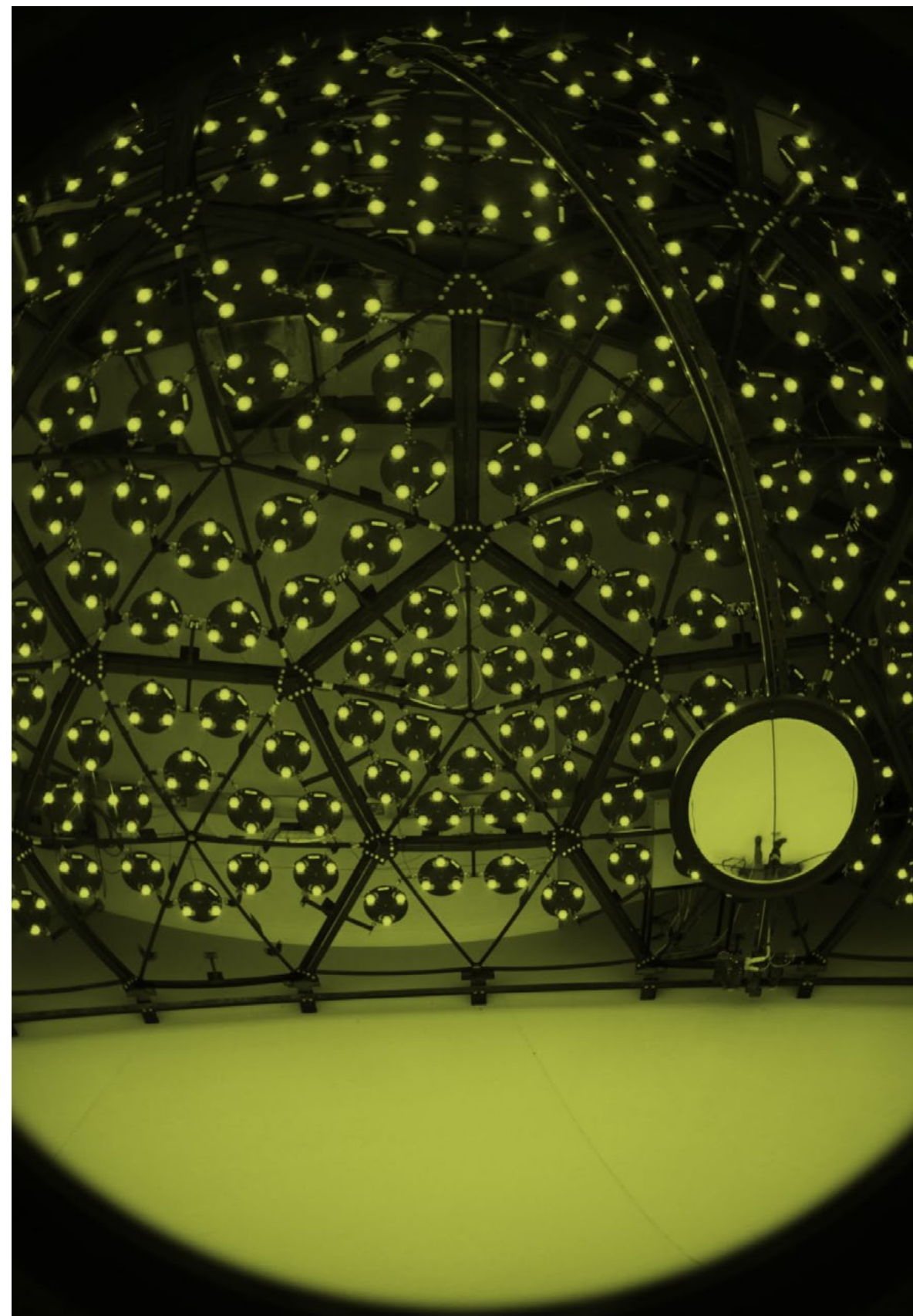
Visiting Professor of Lighting Design and Engineering



Ian Taylor BA(Cantab) DipArch RIBA

Managing Partner, Feilden Clegg Bradley Studios (FCBStudios)

Visiting Professor of Environmental Design and Architecture



Staff list

Management and administration

Dejan Mumovic
Director

Mike Davies
Deputy Director

Harry Barton
Communications, Marketing and Events
Administrator

Ella Strickland de Souza
Communications, Marketing and Events
Administrator

Research Associates

Francesco Aletta

Clare Heaviside

Nishesh Jain

Charlotte Johnson

Young Lee

Valentina Marincioni

Gemma Moore

Tin Oberman

Eleni Oikonomou

Irene Pluchinotta

Peter Rickaby

Yair Schwartz

Serban Scriciu

Daniel Godoy Shimizu

Teaching Fellows

Edward Barrett
Teaching Fellow in Engineering and
Architectural Design

Andrea Botti
Teaching Fellow in Engineering and
Architectural Design

Virginia Gori
Teaching Fellow in Building Physics and
Energy

Aurore Julien
Teaching Fellow in Engineering and
Architectural Design

Gordon Lowry
Teaching Fellow in Engineering and
Architectural Design

Valentina Marincioni
Teaching Fellow in Building Physics and
Energy

Dashamir Marini
Teaching Fellow in Building Performance
Simulation

Samuel Stamp
Senior Teaching Fellow in Building
Performance

Cosmin Ticleanu
Teaching Fellow in Engineering and
Architectural Design

Yi Zhang
Teaching Fellow in Engineering and
Architectural Design

Academic Staff

Hector Altamirano
Associate Professor In Environmental Design
and Engineering

Sarah Bell
Professor of Environmental Engineering

Esfand Burman
Lecturer & Research Associate in Complex
Built Environment Systems

Stephen Cannon-Brookes
Associate Professor in Lighting

Ben J F Croxford
Professor of Environmental Design and
Engineering

THE BARTLETT
INSTITUTE FOR ENVIRONMENTAL
ENGINEERING

Michael Davies
Professor of Building Physics and the
Environment

Sung-Min Hong
Lecturer in Energy and Buildings

Gesche Huebner
Lecturer in Sustainable and Healthy Built
Environments

Jian Kang
Professor of Acoustics

Ivan Korolija
Lecturer in Building Systems Modelling

Kevin Mansfield
Associate Professor in Lighting

Anna Mavrogianni
Associate Professor in Sustainable Building
and Urban Design

Dejan Mumovic
Professor of Building Performance Analysis

Helen Pineo
Lecturer in Sustainable and Healthy Built
Environments

Rokia Raslan
Associate Professor in Building Performance
Simulation

Peter Raynham
Professor of the Lit Environment

Dimitrios Rovas
Associate Professor in Building Physics

Samuel Stamp
Teaching Fellow in Building Performance

Phil Symonds
Lecturer In Machine Learning For Smart
Buildings and Cities

Farhang Tahmasebi
Lecturer in Engineering and Architectural
Design

Jonathon Taylor
Lecturer in Healthy Buildings

Marcella Ucci
Associate Professor in Environmental and
Healthy Buildings

Jemima Unwin
Lecturer in Light and Lighting

Nicole Zimmermann
Associate Professor in System Dynamics

Honorary Staff

Zaid Chalabi
Honorary Senior Lecturer

Clive Shrubsole
Honorary Senior Research Associate

Navaz Davoodian
Honorary Senior Research Associate

Sani Dimitroulopoulou
Honorary Senior Lecturer

Ian Durbin
Visiting Professor

Timothy Dwyer
Honorary Professor

Florence Lam
Visiting Professor

Paula Lopez-Arce
Honorary Research Associate

Alexandra Macmillan
Honorary Senior Research Associate

Ljiljana Marjanovic-Halburd
Honorary Lecturer

Emily Nix
Honorary Research Associate

Foroutan Parand
Honorary Senior Lecturer

David Peck
Honorary Senior Lecturer

Ian Taylor
Visiting Professor

David Trew
Honorary Lecturer

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