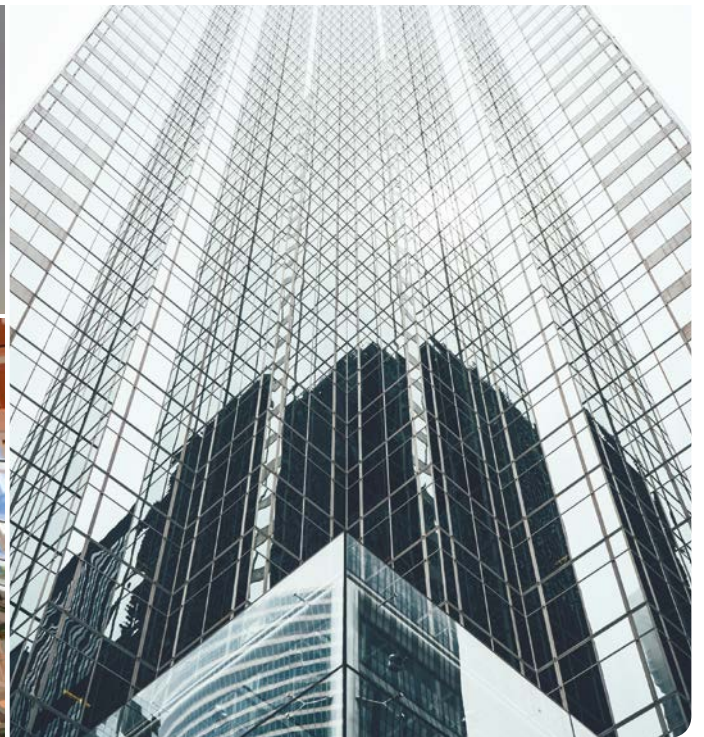


# BRE Trust Annual Review 2018-19



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## Chairman's foreword



The BRE Trust can only continue to be successful if it aligns its activities with the changing needs of those who deliver, operate or occupy the physical assets of the modern built environment.

Our strategy, which was launched in 2017, is driving this by:

- **Delivering** a research and education programme which remains relevant to current and future global drivers and challenges
- **Extending** international engagement through communications, networking and new partnerships
- **Embracing** the use of new technologies in our research and to deliver the outputs to support wider benefit to our community

The standards, testing and training schemes delivered by our subsidiaries in BRE Group and our external partners are a fundamental contributor to the impact we have achieved by ensuring the assets, products and skills of the people that they certify meet the needs of our industry. Their ongoing input to inform our programme and deliver key outputs remains critical.

In January 2019 we also engaged with over 100 key stakeholders at our Annual Conference to discuss how global drivers are affecting the built environment and to validate our future priorities. Going forward we will focus on three main themes:

- **Health, Safety and Wellbeing:** advancing understanding of how factors such as lighting, temperature, acoustics and air quality in buildings affect our physical and mental health
- **Accessible Sustainability:** demonstrating how greater lifetime performances and improved sustainability can be achieved within a wider asset base, in the UK and abroad
- **Adaptation and Resilience:** increasing the application of products and technologies that support the modification and upgrade of assets to meet changing needs, responding to environmental factors

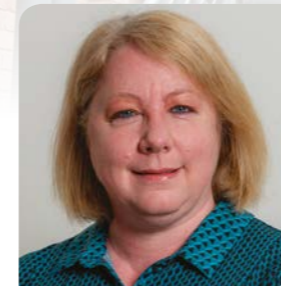
We continue to seek input and engagement from those who wish to shape, fund, deliver or directly benefit from our programme. Please contact us via the secretariat with your thoughts and ideas ([secretariat@bretrust.org.uk](mailto:secretariat@bretrust.org.uk)).

Finally, I'd like to thank Ashley Pocock, Sam Stacey and Peter Lobban, who finished their terms as trustees in the last year, and I would also like to welcome Sarah Beale, Vicky Pope, Jonathan Rickard and Paul Hetherington as new trustees. The success of the Trust is reliant on having constructive and robust guidance, insight and governance, and the trustees play a vital role in providing this. For this Deborah Pullen and I are continually grateful.

**Sir James Wates CBE**  
Chairman BRE Trust



## The BRE Trust Programme 2018-19



### Summary of programme outputs in the last year

It is vital that the Trust continues to maximise its resources and increases the impact of its outputs that drive quality and performance improvements of buildings and infrastructure.

The last year has been one of consolidation and evaluation and the Trust expended £918k on its research and education programme, which attracted a further £1.22m leveraged cash via partners and additional external sources of funding. This included £173k funding allocated for six new projects which will continue into 2019.

This work has increased understanding of aspects of the impact of synthetic lighting, poor air quality and building maintenance and repair on health and wellbeing of occupants. This has provided guidance to those responsible for funding and specifying improvement interventions.

Our work to support the resilience to independent living for longer, especially for those suffering from dementia resulted in the development of an assessment framework and launch of a new demonstrator building hosted on the BRE Innovation Park. Other critical areas supporting the evaluation of methods to detect and respond to fires and also effective and affordable responses to flooding have continued.

Our education programme saw 15 PhD studentships graduate this year and also £233k funding committed to four new studentships, which will start in 2019. Two professorships, three lectureships and 11 other studentships continue to be part-funded.

The work supported by the BRE Trust is shared using a range of dissemination methods, and in the last year 55 new publications and technical articles, 95 peer-reviewed scientific papers and 32 conference presentations were published. Outreach is reflected in sales of publications through BRE Bookshop exceeding 3,000 units, Construction Information service saw over 110,000 downloads across over 700 titles.

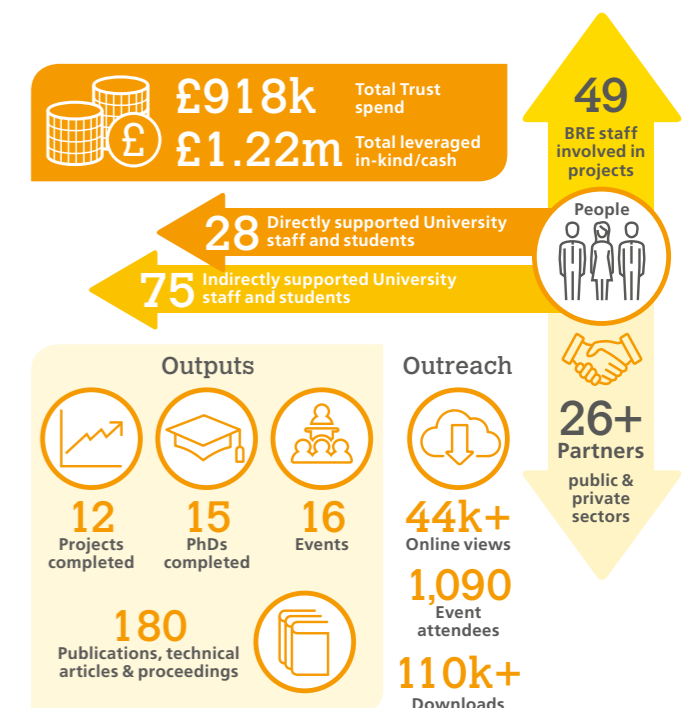
There were more than 44,000 views of the 125 articles hosted on [www.designingbuildings.co.uk](http://www.designingbuildings.co.uk) during the year, which illustrates the significant increase in our outreach through online information platforms. We have also just launched a new knowledge hub, [www.bretrust.org.uk/knowledgehub](http://www.bretrust.org.uk/knowledgehub), which will allow us to provide more detailed information and also support wider engagement with collaborative project teams involved in delivering our programmes.

In 2020 we will be launching a new programme focused on the measurement and monitoring of physical assets and would be delighted to speak to anyone who is already engaged in research which is advancing the understanding and application of methods of measurement and analysis of data at full scale and in real time. This will be launched at the Annual Conference being held in January 2020.

**Dr Deborah Pullen MBE**  
Executive Officer BRE Trust

Since its launch, the BRE Trust has provided over £25m funding to more than 150 studentships, and 200+ other research and dissemination projects. This has leveraged over £50m in additional cash, resulting in more than 1000 peer-reviewed papers, 300+ new technical publications and 25+ new training courses.

### 2018 / 2019 BRE Trust Year Summary



## Awards

During the last year the BRE Trust has part-funded a number of awards, and our projects and sponsored students have been the recipients of other, external awards. A selection of these are summarised.

### Research award for young constructors

The BRE Trust co-funded the Royal Charter International Research Award for Young Constructors 2018, which was presented to Dr Alastair Marsh (University of Reading) at the Worshipful Company of Constructors' Livery & Awards Dinner in February 2019. He received the award for his project with charity HYT Uganda, on using waste rice husk ash as a supplementary cementitious material in sustainable, low-cost cement-stabilised earth blocks (CSEBs).

With deforestation caused by gathering firewood for fuelling brick kilns, and CO<sub>2</sub> emissions from the firing process, fired-clay brick manufacture is unsustainable in many developing countries. CSEBs are made with sub-soil, with small amounts of Portland cement added to ensure durability. Reducing this cement content – whilst maintaining durability and quality – could further improve affordability and sustainability. A full report is on the BRE Trust website.



A project in Uganda on reducing the cement content of cement-stabilised earth blocks, could help to develop more affordable and sustainable housing. (Image: HYT Uganda)

### Flood resilience project recognised

The Flood Resilient Repair Home (see page 8) on BRE's Innovation Park was the winner of the Innovation Award in the Flood and Coast, Project Excellence Awards 2018. This award recognises projects that identify and implement new ways of meeting challenges to deliver projects better, faster, more safely or more efficiently. The home was also shortlisted for the Barclays Developing Resilience Award 2018.

### Fire technology award

PhD graduate Dr Juan Hidalgo Medina received the 2018 Tibor Harmathy Award for a paper co-authored by supervisors Stephen Welch (University of Edinburgh) and Jose Torero (formerly UoE, now UCL) – all then members of the BRE Centre for Fire Safety Engineering. Published in Fire Technology, the paper, 'Experimental Characterisation of the Fire Behaviour of Thermal Insulation Materials for a Performance-Based Design Methodology', was nominated by the Editorial Board as one of the best papers and then judged to be the Harmathy winner by the Associate Editors.

### Britain-Australia travel award update

In 2017 an international study exchange was facilitated through the Worshipful Company of Engineers' (WCE) Sir Peter Gadsden, Britain-Australia Travel Award. This has allowed Aurimas Bukauskas, a University of Bath PhD student supported by the BRE Trust, to spend six months studying at the University of Queensland, while Australian PhD student, Ian Pope, studied at Edinburgh University Centre for Fire Safety Engineering.

Aurimas' research aims to facilitate the greater use of sawn 'whole timber' that can be obtained from a much wider range of tree types than those used for sawn-timber – the disproportionate demand for which leads to low-diversity, overstocked forests.

With the help of the travel award, he has been able to travel to Australia to spend time using the specialist capabilities at Queensland University's Timber Hub, and work collaboratively on the inventory-constrained structural design of lightweight timber structures.

## Completed projects

Research supported by the BRE Trust is generating new knowledge and innovations to help meet current and future challenges, from built environment resilience to the wellbeing of people at home and in the workplace. A selection of projects completed in 2018-19 are summarised.

### The full cost of poor housing in Wales

*"It makes sense to invest in improving housing rather than paying for the consequences of poor housing – damaged physical and mental health and reduced wellbeing and prosperity – through the NHS and other agencies."*

This is among the conclusions of a report on research commissioned by the BRE Trust, Public Health Wales and the Welsh Government, which also found that tackling poor housing conditions does not have to be expensive and has multiple benefits.

The full cost of poor housing in Wales report is available on the BRE Trust website. [www.bretrust.org.uk/2019/05/13/the-cost-of-poor-housing-in-wales](http://www.bretrust.org.uk/2019/05/13/the-cost-of-poor-housing-in-wales)



An example of poor housing issues addressed – this home has rear garden and garage access via steep steps that are in disrepair, slippery, and have rain water drainage discharging onto them.

### Circadian lighting

Levels of exposure to light, particularly blue light, can maintain or alter the body's circadian clock. Circadian lighting systems aim to improve people's alertness during day or working hours using bright light – then switch to lower brightness and warmer colours during relaxation times.

In this BRE Trust funded project, a field study in an open-plan office with 23 participants investigated various lighting conditions over several weeks in winter, combining monitoring and occupant reaction. It has developed general recommendations for circadian lighting to maximise health and wellbeing benefits.

Two papers for publication in the 'Lighting Research and Technology' journal have been prepared and a BRE Information Paper, 'Lighting for Circadian Rhythms' will be published in 2019. The project has attracted additional funding from CIBSE to further analyse and report on the field study results.

### Assessing video fire detectors

A video fire detector is alerted to a fire's presence by identifying the visual characteristic signatures of smoke or flame in its camera's field of view. This enables a quicker response than generally achievable by smoke and flame detectors, and can also provide a visual verification of fire.

There are currently no methods of assessing the capabilities of these detectors for testing and certification purposes. A lack of basic performance benchmark and operational performance tests is the greatest obstacle to developing assessment methods.

BRE Trust supported BRE research to develop these test methods, in collaboration with video fire detector manufacturers, has been summarised in a briefing paper available at [www.bregroup.com/firesafetyresearch](http://www.bregroup.com/firesafetyresearch). It is expected that these methods will support the development of a test standard and associated code of practice.



Video fire detector 'seeing' moving smoke in a large industrial space.



As part of the development of the demonstration house, launched in July 2018, 14 key factors affecting people living with dementia were identified. These are being used to develop an adaption assessment tool.

## Adapting homes for dementia

Home adaptation to deal with an ageing population and the increasing occurrence of dementia, is often driven by grant fund availability and product marketing rather than research-based information.

Launched in July 2018, the demonstration 'Chris & Sally's house' on BRE's Innovation Park is providing the information showcase needed to help construction professionals, healthcare professionals and relatives to better support those living with dementia. Its design and construction involved a team with backgrounds in architecture, supportive environments, clinical healthcare and refurbishment. As part of this process, 14 parameters common in most housing were identified as having both negative and positive effects on someone living at home with dementia.

A BRE Trust supported research project is using these parameters to develop a guidance matrix for creating a consistent and measurable approach to domestic property adaptations for dementia – similar to that of environmental performance certificates (EPCs). This includes developing an adaption assessment tool and testing its use with the help of a Dementia Working Group.

## Continuing impact of the flood house

The delivery in 2017 of the Flood Resilient Repair House on the BRE Innovation Park was supported by the BRE Trust – particularly the dissemination of knowledge gained from this project – under its Environment Resilience Thematic Programme. The house has been a successful demonstration of flood resilience measures and an important research and learning facility – and has had a continuing impact.

For example, it has linked into training courses and produced a number of case studies showing how the design of this system could be incorporated into new build and existing properties in flood risk areas. The flood house has inspired a number of follow-on projects in flood affected communities, including the Cumbria Flood Resilience Showcase Project and the entrance theme for the Environment Agency's Flood and Coast 2019 exhibition.

The house has also helped BRE to become a source of practical property flood resilience expertise, an example being BRE's appointment as authoring team lead of the CIRIA Code of Practice (CoP) for Property Flood Resilience.

This CoP is the first document of its kind to support the development of a clear industry process for what has, in previous flooding events, presented challenges in terms of industry collaboration. It utilises a wide range of industry standards and good practice guidance, as well as the advice of a large project steering group. The CoP has attained UK Government support through its 25 Year Environmental Plan, and specific supplementary guidance is being developed for property owners and planning authorities for all areas of the UK.



## Examples of current projects

### Indoor air quality sensors and monitors

Ensuring good indoor air quality (IAQ) requires continuous monitoring, but the quality of the growing numbers of sensors and monitors available is variable and robust protocols for testing them are needed. This project is investigating the performance of various commercially available VOC and CO<sub>2</sub> sensors/monitors in controlled environmental chambers at BRE. It will provide the basis for test protocols for use when developing standards against which sensors/monitors can be certificated.

### Fire death and serious injury investigation

UK domestic fire death numbers appear to have plateaued in recent years after more than three decades of decreasing fatalities. In this project a group of fire experts is analysing data gathered by Fire and Rescue Services and reviewing the causes of fire deaths and the circumstances of serious fire related injuries. The outputs will be used to produce guidance on the effect that using new technologies or services can have on reducing deaths and injury from fire in homes.

### Suppressing biomass fires using wetting agents

Biomass fuels derived from organic matter to generate heat and/or electricity, are typically stored in large outdoor piles or waste processing plants. In some circumstances they can ignite and may take a long time to control, causing severe environmental damage. The Fire Industry Association has identified wetting agents (added to water) that increase the spreading and absorption of water on solid substrates, potentially increasing its effectiveness in extinguishing biomass fires. This research is extending that work to identify how fire and rescue services can use wetting agents most effectively on biomass fires.



IAQ sensors and monitor performance is being investigated in BRE's room-sized environmental chambers, such as this 40m<sup>3</sup> occupiable chamber.

### How long before replacing smoke detectors?

UK codes and regulations have no recommendations for when smoke detectors should be replaced. Detector performance and sensitivity changes with time and as components become dusty and electrical components degrade. This project is testing smoke detectors in domestic and commercial environments to identify the mean and spread of their sensitivities with age, and analysing this data to propose replacement periods. This will enable UK codes and guidance to be updated and will influence other countries to adopt more appropriate replacement periods based on research.

### Real estate asset reporting platform

Real estate asset information is created and stored in various metrics and databases, making it difficult to report performance and assess how to improve assets. This Redevco supported project is developing a centralised digital platform. Users will input, receive and export instantaneous data in the format they require, creating a common reporting framework and KPIs for the various user groups and building types. It will encourage the market to use realistic, actual performance metrics instead of theoretical modelled benchmarks.

### Sustainable post-disaster relief – QSAND

QSAND helps natural disaster responders to ensure that affected communities have viable futures after the relief workers have gone home – and are more resilient to further disasters.

This Redevco supported phase of QSAND's development and delivery – in partnership with Catholic Relief Services – includes producing case studies of QSAND use in Nepal and the Philippines (see page 11), exploring partnerships with development organisations to apply QSAND in the Middle East and South America, and developing disaster relief learning and awareness facilities.

### Retrofit training modules

The Each Home Counts review recommended introducing a quality mark and supporting technical codes of practice and standards for designing and installing energy efficiency measures and renewable energy systems. As upskilling and training those delivering such installations is a key factor, the BRE Trust has funded BRE Academy to develop six 20-30 minute, on-line modules on retrofit issues – building physics, airtightness, applying external wall Insulation, exposure assessment moisture awareness and unintended consequences. These are due to be launched later in 2019.



# Publications

Disseminating built environment knowledge and expert guidance to those who can make the most effective use of it is a vital component of our work. A selection of this year's publications are summarised.

## Interior design guides

Recently published BRE Trust guides provide expert design and regulatory advice on three critical aspects of indoor environment quality – Indoor air quality (IAQ), lighting and acoustics.



### Indoor air quality

IAQ is a complex issue with many factors affecting it, including a wide range of pollutants and sources, building types, locations and decor.

The new publication – 'Ensuring good indoor air quality in buildings' – summarises the issues that building owners, architects, designers and facilities managers face when seeking to provide good indoor air quality. It gives an overview of the sources and types of pollutants likely to affect different indoor environments in urban areas, and summarises current regulations, standards and guidance in the UK.

It also includes short case studies to illustrate strategies for improving IAQ.

### Indoor lighting

'Quality indoor lighting for comfort, health, wellbeing and productivity,' informs building designers, owners and occupants of the benefits of careful lighting design that meets the recommendations of codes and standards, and ensures that occupants' visual requirements are met.

It addresses lighting design issues such as the type of activity in the building, health, visual comfort and performance – including issues such as flicker, glare and controls, individual requirements and emergency lighting.

As indoor lighting is not always appropriately designed or installed – adversely affecting wellbeing, comfort, health and productivity – the new publication recommends post-occupancy evaluation of artificial lighting, and presents case studies in which lighting problems have been identified and solutions suggested.

### Acoustic design

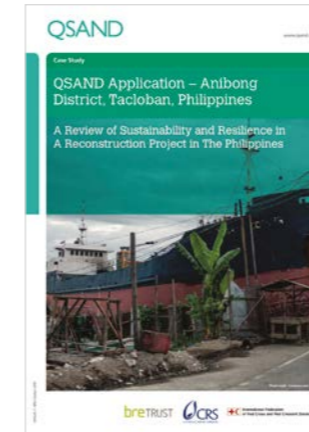
The new guide, 'Acoustic design and testing for health and wellbeing', identifies the basic elements of acoustic design and the standards which are most commonly used when considering the impact of noise on residential properties.

It will help housebuilders, building owners, designers/architects, planners, landlords and householders to take the first steps to understanding acoustic requirements for homes and the kind of technical data they might encounter on the way.

The BRE Trust Knowledge Hub went live over the summer at [www.bretrust.org.uk/knowledgehub](http://www.bretrust.org.uk/knowledgehub). It will support the wider dissemination of our project outputs, and engagement with those who can benefit from them.



## QSAND case studies



The Working Together for Disaster Relief conference in February 2019 (see page 12) saw the launch of BRE Trust supported case studies describing disaster relief operations in Nepal and the Philippines, where QSAND was used to help integrate sustainability and resilience in reconstruction.

QSAND is a self-assessment tool to promote sustainable approaches in post-event recovery and reconstruction. It was developed by the International Federation of the Red Cross and Red Crescent Societies (IFRC) in collaboration with BRE, and with support from the BRE Trust.

### Anibong District, Tacloban, Philippines

The super typhoon that struck the Philippines in 2013 – one of the strongest ever recorded with over 1.1 million houses destroyed or damaged and over 12 million people affected – was responded to by the relief organisation Catholic Relief Services (CRS) and local partner, Caritas Philippines.

In the early stages CRS used QSAND to support sustainability and resilience planning and implementation activities. QSAND was used to review and help identify any gaps in sustainability and resilience programming.

*"QSAND's objective to guide and inform decision making processes promoting more sustainable approaches to shelter and settlement activities was perfect in our case, as it acted as an additional check to help us identify areas of the project where we could add or enhance our sustainability and resilience programme."* Jamie Richardson, Shelter and Settlements Technical Advisor, CRS.

### Gorkha District, Nepal

Two major earthquakes struck Nepal in Spring 2015. More than 6 million people were affected, with more than 600,000 homes destroyed.



In Gorkha district the earthquakes were particularly devastating. CRS and its local implementing partners recognised the need for both quick emergency relief and a long-term plan to secure the livelihoods of the worst affected communities. They therefore chose to implement QSAND to help ensure that shelter reconstruction met the needs of the local population, and was led by community members who would maintain these structures in the future.

## Wood in healthy buildings

BRE's Dr Ed Suttie, launched a new TRADA (Timber Research and Development Association) Briefing document at the Timber Trade Journal's Wood and Wellness Conference in February 2019.

The Briefing document, *The role of wood in healthy buildings*, investigates and discusses the potential roles for timber in supporting health and wellbeing. Prepared by Dr Suttie with funding support from the BRE Trust, it brings together and summarises a wide range of international research on the impact of nature and natural products on health and wellbeing, and focuses on how the inherent qualities of wood can contribute to healthier buildings.

*"It points towards how we as an industry can work together to fundamentally start to deliver health and well-being through the use of timber and timber products in buildings and construction,"* said Dr Suttie. More information and access to this report is available at [www.trada.co.uk](http://www.trada.co.uk)

## Creating positive spaces by measuring the impact of your design: De-mystifying POE (Pre- and Post-Occupancy Evaluation)

Two of BRE's partners in the Biophilic Office project, Interface and Oliver Heath Design (OHD) are working on a series of guides on human-centred design, aimed at designers, decision makers, end users and influencers in the built environment.

The first three guides cover the 'WELL' building standard, biophilic design and designing for community. The fourth, and the focus of this BRE Trust supported project, is *Creating Positive Spaces by Measuring the Impact of your Design: De-Mystifying POE (Pre- and Post-Occupancy Evaluation)*, for which BRE has provided the technical content.

BRE is working with OHD on the structure and content of the publication and with Interface on marketing the report, which is due to be launched at the end of this year. It will be co-badged by BRE, Interface and OHD, and will be distributed internationally in a range of languages.



Reconstruction in the Philippines. Photo: IFRC.



## Events

During 2018-19 the BRE Trust hosted or supported a range of events, from its Annual Conference to monthly lectures on humanitarian design, a selection of which are summarised here.

### Annual conference

*"It is vital that the Trust remains relevant to the needs of the industries we support,"* said Sir James Wates CBE at the BRE Trust Annual Conference in London in January 2019. Conference speakers – including Suzannah Nichol, CEO of Build UK, and Tim Embley, Group Innovation & Knowledge Manager at Costain – and delegates analysed the key challenges facing the industry to help the Trust direct its resources in ways that deliver the most positive impacts.

A report summarising these discussions is at [www.bretrust.org.uk/learning-and-skills/publications](http://www.bretrust.org.uk/learning-and-skills/publications)

### Disaster relief

The Working Together for Disaster Relief conference, organised by BRE, Catholic Relief Services and Save the Children – and supported by the BRE Trust – was hosted at BRE in February 2019.

Open to all agencies involved in post-disaster response, the conference focused on how they can collaborate more effectively. It included presentations on current and proposed initiatives, and workshops on how humanitarian, government, academic and private partners can best work together.

Two case studies on the use of the QSAND disaster response tool – published with BRE Trust support – were launched at the conference (see page 11 for details). report on the event is available at [www.bretrust.org.uk/events](http://www.bretrust.org.uk/events)

### Wellness and biophilia

How can nature-inspired design foster workplace wellness? What are the key interventions that can capitalise on the return on investment in refurbishment? These were just two of the many questions addressed at the Wellness and Biophilia Symposium, supported by the BRE Trust and hosted at BRE on 6-7 June 2019.

This was also the launch event for the Biophilic Office, a long-term research and demonstration project from BRE and Oliver Heath Design – to which the BRE Trust is contributing dissemination support – that is gathering evidence for the impacts on people and business of nature-inspired design and technology in the built environment.

### Making design matter

The BRE Trust partners with Article 25 to provide support for its monthly talks programme, Make Design Matter. The programme promotes, publicises and disseminates the positive social, economic and environmental impacts that humanitarian architecture and construction projects are having across the world. For detail of these expert talks visit [www.article-25.org/events](http://www.article-25.org/events)

*"Thank you so very much to all at the BRE Trust for your support to this important dissemination and promotion effort in the UK,"* said David Murray, Article 25's Managing Director. *"It is really helping to showcase the important work and impact that human-centred design and construction is having on communities across the world."*

Colour workshop at the Wellness and Biophilia Symposium



## University partnerships

The BRE Trust works closely with a network of leading universities, providing support for new staff roles and awarding scholarships and bursaries to PhD students. This supports capacity building and skills development to drive the innovations needed to develop and enhance the built environment in the coming decades.



### University of Bath

The BRE Centre for Innovative Construction Materials at the University of Bath ([www.bath.ac.uk/ace/research/cicm](http://www.bath.ac.uk/ace/research/cicm)) conducts leading research, development and consultancy in the field of innovative and sustainable construction materials and technologies.

#### Centre Director – Pete Walker

Professor Pete Walker is Director of the BRE Centre for Innovative Construction Materials. His current research interests cover bio-based construction materials, materials for improved indoor air quality, structural masonry and innovative timber engineering.



Professor Pete Walker is Director of the BRE Centre for Innovative Construction Materials

Over the past year Pete has continued to supervise BRE Trust funded PhD student Fiona Glead, developing flood resilience for traditional masonry walls using sol gel treatments for mortars. Other research projects have included a UKIERI supported collaboration with the Indian Institute of Science in Bengaluru, developing geopolymer stabilisation of novel masonry materials, and a European collaboration developing waste and bio-resources for building insulation materials.

#### PhD Studentships completed in 2018-19

##### Will Hawkins – Simultaneous interactive form finding and structural optimisation for flexibility formed concrete structures

This project brought together modern developments in computational design, material technology and construction methods to explore the feasibility of a widespread application of concrete shells as floors in multi-storey buildings, in order to create a low-embodied-energy alternative to traditional reinforced concrete flat slabs.

##### Fiona Glead – Flood resilience: Improving building drying times

Post-flooding reviews have highlighted the need to improve resilience, with drying of buildings identified as a key factor. This study has identified experimental and analytical methods of exploring moisture absorption, migration and desorption during a cycle of flooding and drying, in order to develop a better understanding of the behaviour of masonry wall structures.

#### PhD Studentship started in 2018-19

##### Lorena Skevi – Self-healing concrete

Self-healing concrete has the potential to transform our building materials, enhance durability and serviceability and reduce maintenance costs. This project aims to develop smart, cement-based materials with self-healing and repairing capabilities.

It is using bacteria that can microbiologically precipitate calcite in cracks. Previous studies show that bacteria-based self-healing of mortar can return the permeability of cracked mortar to that of uncracked mortar under laboratory conditions. This project is investigating how to ensure that self-healing occurs in concretes in conditions that are present in practice.



THE UNIVERSITY  
of EDINBURGH



Professor Grunde Jomaas receiving the David Lucht Lamp of Knowledge Award in Nashville, USA



Dr Angus Law is the BRE Lecturer in Fire Safety Engineering

## University of Edinburgh

The only centre of its kind in the UK, the BRE Centre for Fire Safety Engineering at the University of Edinburgh ([www.fire.eng.ed.ac.uk](http://www.fire.eng.ed.ac.uk)) is equipping tomorrow's leaders in this field with the skills they need and supporting today's fire safety with multidisciplinary research.

### BRE Chair of Fire Safety Engineering – Grunde Jomaas

Professor Grunde Jomaas conducts combustion and fire safety science research on topics that include spacecraft fire safety, ignition and flame spread in microgravity environments, oil burning on water, photovoltaic panel fires, high pressure gas combustion, flame front instabilities, fire risk analysis, and fire dynamics in compartments.

Grunde is the local programme coordinator for the International Master of Science in Fire Safety Engineering ([www.imfse.ugent.be/](http://www.imfse.ugent.be/)), which is co-organised with Lund University and Ghent University. In October 2018 he received the David Lucht Lamp of Knowledge Award ([www.sfpe.org/general/custom.asp?page=LuchtRecipients](http://www.sfpe.org/general/custom.asp?page=LuchtRecipients)) on behalf of IMFSE for the programme's 'substantial contribution to increasing the opportunities for higher education in fire protection engineering'.

### BRE Lecturer in Fire Safety Engineering – Angus Law

Dr Angus Law works on developing design methods for use in industry, and ensuring practitioners have the skills and knowledge needed to implement fire engineering designs safely and effectively.

Angus is currently involved in research projects relating to cladding fires, engineered timber buildings and societal aspects of regulation. Highlights from the past year include his involvement in competency working groups providing input to the government's Review of Building Regulations and Fire Safety.

### PhD studentship completed in 2018-19

#### Ben Ralph – Multi-scale modelling of fires in modern high-rise buildings

The majority of fire fatalities occur outside of the room of fire origin and are due to smoke inhalation. Two way fire-building interaction is an important factor in a fire's growth and spread. This BRE Trust /EPSRC supported project developed a framework for modelling the total building system within industry-accepted timeframes, by using coupled hybrid modelling – the coupling of computationally less expensive models and more expensive models with more fidelity. The novel model implementation has been benchmarked against medium scale experiments carried out as part of the project and is integrated into the most widely used open source fire model.

### PhD studentships started in 2018-19

#### Vasileios Koutsomarkos – A fire robustness index for buildings

This project aims to develop a fire robustness index for assessing a building's ability to withstand a fire event. It will provide a science-focused and data-reinforced approach that effectively contributes to risk-informed decision making and cost-efficient design solutions. This approach could help designers to go beyond compliance to achieve a higher standard of fire safety than is required by legislation.

#### Arjan Dexters – Testing for knowledge: maximising information obtained from fire tests by using machine learning techniques

Current fire testing procedures to demonstrate the compliance of construction materials with regulations are benchmarked against a specific hazard scenario – so any actual fire exposure will inevitably differ from the test situation (duration, maximum temperature, etc.). This project aims to develop a machine learning algorithm to predict large-scale test results based on parameters obtained from bench-scale tests. The method will be particularly useful for assessing and understanding the behaviour of innovative materials and design solutions, and will also allow for a more nuanced ranking than currently offered by the commonly used classification methods for reaction to fire tests.



## University of Strathclyde

The Energy Systems Research Unit (ESRU) is a cross-discipline research group concerned with new approaches to built environment energy utilisation and the introduction of sustainable means of energy supply at various scales. ESRU is located within the Department of Mechanical and Aerospace Engineering and operates the BRE Centre for Energy Utilisation.

### BRE Lecturer in the Energy Systems Research Unit – Daniel Costola

Dr Daniel Costola holds the BRE Lectureship in the Energy Systems Research Unit of the University of Strathclyde. He works on advancing modelling and monitoring of energy systems within the built environment. His publications last year addressed topics ranging from applied research in adaptive facades to fundamental issues affecting dwellings in developing countries. He has also been working on improving existing energy regulations and developing tools to tackle the building performance gap.

This wide research work benefits from the support of the BRE Trust, which is also instrumental in fostering collaboration in education (as in the Passive House course and certification offered through the BRE Academy), and knowledge exchange (through projects carried out with BRE benefiting companies and local authorities). The goals for next year include improving calibration for reliable retrofit design and enhancing the assessments of indoor environmental quality to better identify issues affecting the performance and health of building occupants.

### Studentship Completed in 2018-19

#### Maddelana Lovene – Towards informal planning: mapping the evolution of spontaneous settlements in time

This project investigated the internal structure and the physical and societal evolution of an informal settlement in Lima, Peru, to enable urban models and settlement patterns to be generalised and classified, and to identify recognisable characteristics of urban change at a global level. This type of work is essential for informing built environment policy as there is a lack empirical evidence to support decision-making. The work identified the evolution of occupation patterns in time, allowing the development of dynamic models to estimate the evolution of such settlements.

## University of Hertfordshire

The University of Hertfordshire School of Engineering and Computer Science has an important academic partnership with BRE. They are currently working together to deliver BEng and MEng Civil Engineering courses.

First-year students visit BRE for a week to undertake laboratory preparation and testing of concrete, plus tensile testing of steel and assessing the anisotropic nature of timber. They also receive introductory lectures on BIM, BREEAM and CEEQUAL. BRE delivers much of the construction management module to second-year students, and next year's programme will include teaching of the third-year students on sustainable engineering topics as well as supporting final year projects. Antonios Kanellopoulos, a civil engineer and a senior lecturer in the school, is the primary contact with BRE for this course.

The BRE Trust is providing funding for a new lecturing appointment at the school, due to start in September 2019. The Trust has also provided funding for three studentships focused on smart technologies which have linked into the smart connected homes programmes run by BRE.

### Studentship completed in 2018-19

#### Anthimos Ioannidis – Real-time control and optimization of electricity networks with local energy generation and storage

The use of intelligent monitoring systems has made a plethora of energy data available, providing opportunities for better understanding building energy operations. This project has addressed the difficulties in obtaining information from such datasets because of their volume, variety and velocity, proposing a novel smart meter data modelling and classification approach.



University of  
**Strathclyde**  
Glasgow



Daniel Costola, BRE Lecturer in the Energy Systems Research Unit at the University of Strathclyde ([www.strath.ac.uk/research/energysystemsresearchunit](http://www.strath.ac.uk/research/energysystemsresearchunit))

University of  
**Hertfordshire** **UH**



Antonios Kanellopoulos, a senior lecturer in the school of Engineering and Computer Science ([www.herts.ac.uk/study/schools-of-study/engineering-and-computer-science](http://www.herts.ac.uk/study/schools-of-study/engineering-and-computer-science))





**Loughborough University**



Dr Long Seng To



Dr Christina Hopfe



Dr Chris Goodier



Dr Lee Boshier

## Loughborough University

A new collaborative partnership was launched in 2015 with The School of Architecture, Building and Civil Engineering, Loughborough University ([www.lboro.ac.uk/departments/abce](http://www.lboro.ac.uk/departments/abce)), with the BRE Trust providing additional funding to support five PhD studentships – all related to different aspects of sustainability, including the performance gap, circular economy and responsible sourcing in the construction sector.

There are now two new studentships underway, and Dr Chris Goodier, Dr Christina Hopfe and Dr Lee Boshier are working closely with the BRE Trust to define the priorities for research, education and teaching in relation to improving the resilience of built assets to external environmental stresses. This will also encompass our developing relationship with Dr Long Seng To in The School of Social Sciences on aspects of sustainable energy and post-disaster rebuild.

### Studentships completed in 2018-19

#### Asselya Katenbayeva – Traceability in the construction supply chain

Traceability is key to verifying sustainability claims associated with the sourcing, production and transformation of products as they move along supply chains. This project included proposing and validating a set of measures of traceability, and providing recommendations on how the construction industry can improve traceability implementation.

#### Konstantinos Mourkos – Increasing the reliability of using dynamic simulation in predicting overheating risk in domestic buildings

As current methods of addressing overheating can have limitations, such as failing to consider uncertainties from various contributing factors, their effectiveness is debatable. This project has proposed a systematic approach to increase confidence in overheating predictions in residential buildings and so reduce the associated performance gap.

#### Katherine Adams – Embedding a circular economy in the UK building sector

Reuse, repair, recycling and remanufacturing, so that material resources retain their value for longer, is a key circular economy issue. This project has developed a systematic method of embedding circular economy throughout a building's lifecycle. That included determining circular economy principles and their application at each lifecycle stage, taking the supply chain roles into account, as part of developing a strategic level framework.

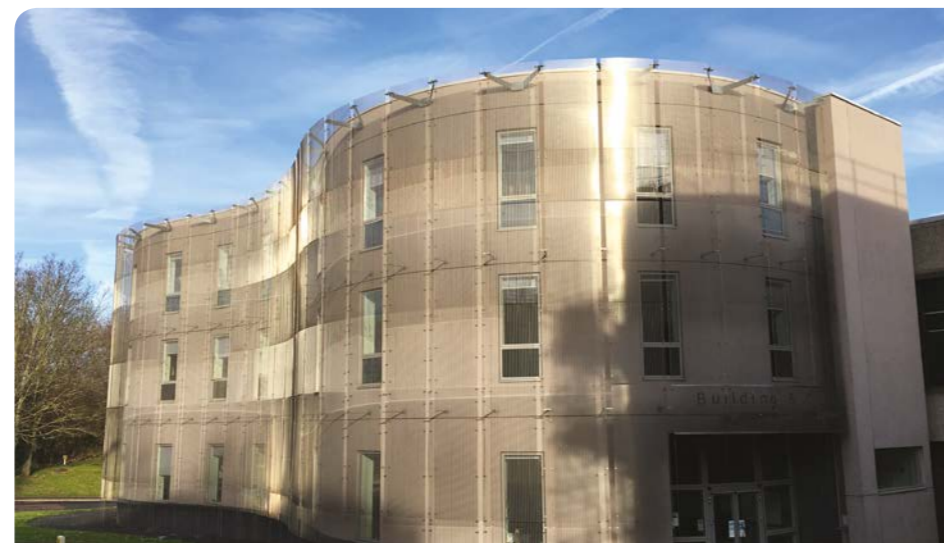
### Studentships started in 2018-19

#### Alistair Wilson – Blockchains for traceability assurance

While there is growing interest in tracking and tracing construction products through global and complex supply chains, traceability literature is varied, imprecise and confused. Blockchain technology offers a potential solution – blockchains are customised transaction exchange mechanisms that are secure and cannot be changed or tampered with. This project is investigating construction applications, and includes using selected BRE products and services as case studies.

#### Daniel Franks – Building energy and environment: measurement, data, analysis and interpretation

This project is using occupant and building data to categorise energy use at home. Its principal aims are to understand the changes over time of energy demand and temperatures in English homes, the changes in the socio-economic status of households, and how these interact to produce high energy demand and/or fuel poverty.



## Cardiff University

Professor Yacine Rezgui is the Director of the BRE Trust Centre of Excellence in Sustainable Engineering at Cardiff University. He is a qualified architect with more than 20 years' research and teaching experience, having published over 250 refereed publications, graduated 35+ PhD students, and completed 40+ national and European funded research projects in areas related to computing in the built environment (Internet of Things, Semantics, and Artificial Intelligence), with a focus on resilience and smart cities.

### Studentships completed in 2018-19

#### Shaun Howell – Ontological representations for integrated smart cities modelling and data analytics

The convergence of the Internet of Things, artificial intelligence, big data and information modelling could transform built environments. This work offers a benchmark for bringing these together in smart city systems by addressing a key barrier: application layer interoperability. A web platform is proposed which builds on experience in research projects across the energy and water domains, to greatly simplify application development through resource discoverability and semantic interoperability.

#### Corentin Kuster – Total life cycle and near-real-time sustainability assessment

The frameworks that assess sustainability at the building and urban level have been primarily developed for design purposes. This project has used sustainability indicators currently applied in well known assessment schemes such as BREEAM, to deliver an online data driven software tool that can assess the environmental, social and economic quality of a neighbourhood at every stage of its life cycle, in near real-time and regardless of location.

#### Giulia Cere – Holistic and semantic decision and policy-making model for resilient and sustainable urban infrastructures

Currently, resilience is only loosely factored into urban planning strategies. This research has developed an integrated, intelligent, risk-aware, evidence-based, process-oriented, interoperable and replicable MODE2 (monitor – optimise – define – evaluate – evolve) system for developing and evolving cost-optimal disaster resilient building and infrastructure standards applicable at a city scale.

#### Jonathan Reynolds – Real-time and semantic energy management across buildings in a district configuration

To reduce energy use in buildings whilst maintaining occupant comfort, a new generation of building control methods is needed at a district level to take advantage of load sharing, demand response and local renewable generation. This PhD project has developed and trialed a number of control methods, utilising artificial intelligence techniques such as artificial neural networks and genetic algorithms, and taking advantage of modern developments in high performance, cloud computing power.

#### Yu Li – Modelling and developing 'smart' and 'environmentally friendly' engineering materials

District heating and cooling (DHC) systems are attracting increased interest for their low carbon potential, but most are not operating at the expected performance level. This research has paved the way to the 4th generation of DHC systems that promote integration of smart grids, energy storage and increased share of renewable energy.

**CARDIFF UNIVERSITY**



Professor Yacine Rezgui is the Director of the BRE Trust Centre of Excellence in Sustainable Engineering at Cardiff University ([www.cardiff.ac.uk/bre-trust-centre-sustainable-engineering](http://www.cardiff.ac.uk/bre-trust-centre-sustainable-engineering))



# Structure and Governance

The BRE Trust (the "Trust") is a not for profit company limited by guarantee (Company number 03282856) and is registered as a charity in England and Wales (No. 1092193) and in Scotland (No. SCO39320). It is governed by its Articles of Association.

## Objects

As a charity the Trust's activities must at all times meet with its public interest objects set out in the Articles of Association and agreed with the Charity Commission as follows:

- to undertake, commission and support research in areas of science, engineering, information technology, management and economics associated with the built environment, including its processes and artefacts;
- to advance knowledge, innovation, and communication, and to promote education and excellence, in all such matters, and to collect, collate and publish useful information ideas, and data relating thereto; and
- to undertake, commission, facilitate such other activities and services as are beneficial to the built environment and charitable in law in accordance with the law of England and Wales provided that it will not include any purpose which is not charitable in accordance with s.7 of the Charities and Trustee Investment (Scotland) Act 2005. For the avoidance of doubt, the system of law governing the constitution of the Charity is the law of England and Wales.

### Statement of Public Benefit

The Trustees confirm that they have referred to the general guidance on public benefit issued by the Charity Commission when reviewing on an annual basis the Trust's aims and objectives and in ensuring that activities are defined in the Strategy document for 2017-21 and its approved annual business plan. Any benefit received by researchers and research institutes is purely incidental to the objectives of the Trust's work.

## Officers and Trustees of the Charity

### Executive Officer

Dr Deborah Pullen MBE was appointed as the Executive Officer of the BRE Trust on 1st September 2018, and is delegated the

day-to-day management of the Charity by the Trustees, reporting on aspects of the operations of the Charity and progress in delivery of the Programmes to the Council.

### Company Secretary

Mr Richard Tanner was appointed as the Secretary of the BRE Trust on 15th September 2018, providing professional advice and support to ensure the Trust meets its statutory and legal obligations. He also advises on relevant governance regarding the operations and delivery of Trust activities.

### Trustees

The governing body of the Trust is its Council, which comprises at least five and no more than ten Trustees at any point in time. The Directors of the Company are its Trustees for the purposes of charity law. The Chairman is appointed by the Council of Trustees, with the current Chairman being reappointed in May 2018.

### Trustees serving between 1st April 2018-31st March 2019

Sir James Wates CBE, Chairman  
 June Barnes  
 Julia Barrett (appointed June 2018)  
 Sarah Beale (appointed March 2019)  
 Francesca Berriman MBE (reappointed June 2018)  
 Michael Dickson CBE (deceased May 2018)  
 John Hooper (resigned April 2018)  
 Nick Jennings CB (resigned June 2018)  
 Sir Ken Knight CBE (resigned June 2018)  
 Peter Lobban (resigned December 2018)  
 Ashley Pocock (resigned September 2018)  
 Sam Stacey (resigned June 2018)  
 Phil Wilbraham (appointed 7 June 2018)  
 Gary Wingrove (resigned 13 June 2019)

### New Trustees appointed since 31st March 2019

Paul Hetherington (appointed 13 June 2019)  
 Vicky Pope (appointed 13 June 2019)  
 Jonathan Rickard (appointed 13 June 2019)

### Governance

BRE Trust ensures that it achieves its ambitions and aims through effective governance with the right leadership and skills. The Trust's governance model is founded on the Charity Governance Code for Larger Charities. The Trust board is satisfied that it applies the Code:

1. to be clear on the Trust's aims and ensures that these are being delivered effectively and sustainably;
2. to ensure it is led by an effective board that provides strategic leadership in line with the Trust's aims and values;

3. to ensure the board acts with integrity, adopting values and creating a culture which help achieve the Trust's charitable purposes. The board is aware of the importance of the public's confidence and trust in the Trust, and trustees undertake their duties accordingly;
4. to ensure that its decision-making processes are informed, rigorous and timely and that effective delegation, control and risk assessment and management systems are set up and monitored;
5. so that it works as an effective team, using the appropriate balance of skills, experience, backgrounds and knowledge to make informed decisions;
6. so that its approach to diversity supports its effectiveness, leadership and decision-making; and,
7. that it leads the organisation by being transparent and accountable.

### Standing Committees

At the beginning of the year the Trust board had delegated some of its work to two standing Committees, the Trust Programmes Committee and the Audit Committee.

### BRE Trust Programmes Committee

The Committee was formally launched in September 2017 and provides for the direction and governance of commissioned research and education work. The Committee is chaired by Francesca Berriman and five meetings were held in the last year. Three of its Trustee members resigned in-year (Pocock, Dickson and Jenkins) and a new member, Julia Barrett joined the Committee in June 2018.

### BRE Group and Trust Audit Committee(s)

Until July 2019 the Trust had a joint Audit Committee with its direct subsidiary BRE Group Limited. The Committee membership was made up by two non-executive Directors of the BRE Group board (Brigid Sutcliffe (Chair) and Ashley Wheaton) and two Trustees (Barnes and Lobban). Peter Lobban resigned in December 2018 and Sarah Beale joined the Committee in his place. In April 2019 a further Trustee resigned (Barnes) to be replaced at the following meeting (Rickard). The Committee met four times in the year. In July 2019 the Audit Committee was reconstituted so that going forward the BRE Trust and BRE Group Limited each have separate Audit Committees with reporting lines to their respective boards.

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[www.bretrust.org.uk](http://www.bretrust.org.uk)

**BRE Trust**

The BRE Trust uses profits made by BRE Group to fund new research and education programmes, that will help it meet its goal of 'Building a better world together'.

The BRE Trust is a registered charity in England & Wales:  
No. 1092193, and Scotland: No. SC039320.