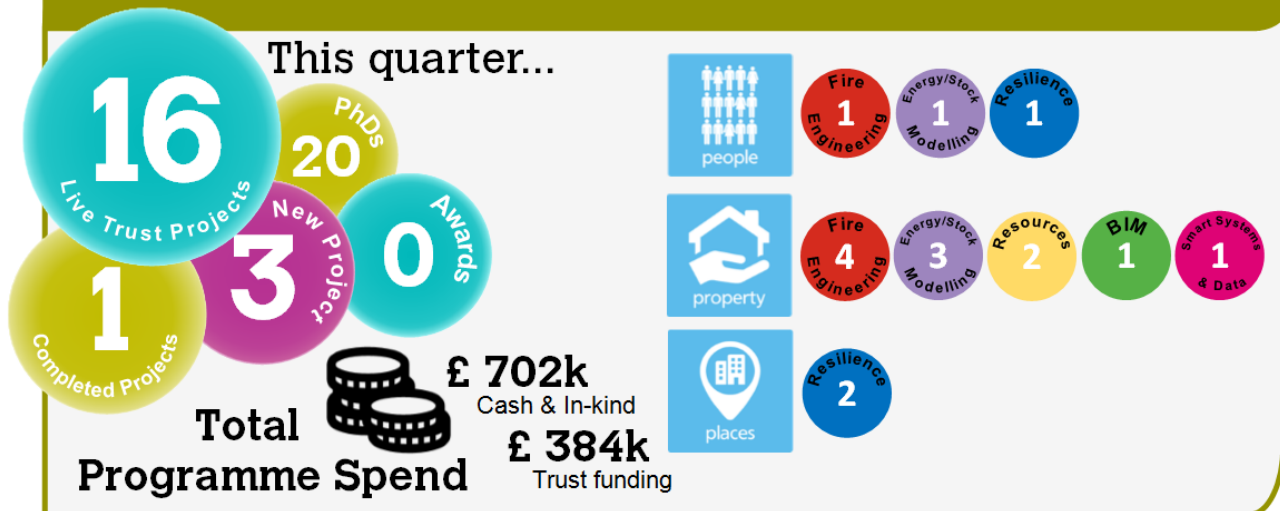


BRE Trust Programmes Quarterly Review July - September 2018

Prepared by the BRE Trust Secretariat



Executive Summary



This review summarises the progress of the BRE Trust's Research, dissemination and partnerships Programmes during July-September 2018.

Projects - we report on three new projects:

The development of robust tests to evaluate **video fire detectors**, ensuring that designers develop reliable products which are specified for appropriate use in a range of building scenarios.

Investigation of the performance of a range of state of the art commercially available **IAQ sensors**. This will underpin the development of robust chamber-test protocols, informing building design and support the health and wellbeing of building occupants.

A publication to raise awareness amongst building designers and the business community, of the benefits of pre- and post- occupancy evaluation.

There also updates on two ongoing projects:

The life-long health effects of poor indoor air quality on infants, children and young people, and the lasting impacts on their health.

Tackling overheating in urban dwellings likely to be exacerbated by climate change, the latest stage of this project will look at ways of improving overheating risk assessment.

Outreach and dissemination

The review includes reports on:

The BRE Academy's work to develop a series of modules on issues to upskill those in the retrofit sector. We also report on the Academy's progress in achieving greater university engagement.

Events – the Construction Excellence Forum on the research, innovation and skills needed in the construction industry, a leaders breakfast meeting on Women in Construction, and an ECI roundtable of owner operators and investors in the engineering construction sector.

Partnerships - we report on:

A partnership building visit to the University of California's Davis campus (UC Davis) to investigate potential collaborative projects and shared learning opportunities.

The Trust's support for a series of Article 25 lectures titled 'Make Design Matter', bringing together experts in humanitarian design, planning and architecture.

Four new PhD studentships on:

- Blockchains for traceability assurance
- Energy demands for heating in homes
- A Fire Resilience Assessment Methodology
- Self-healing concrete

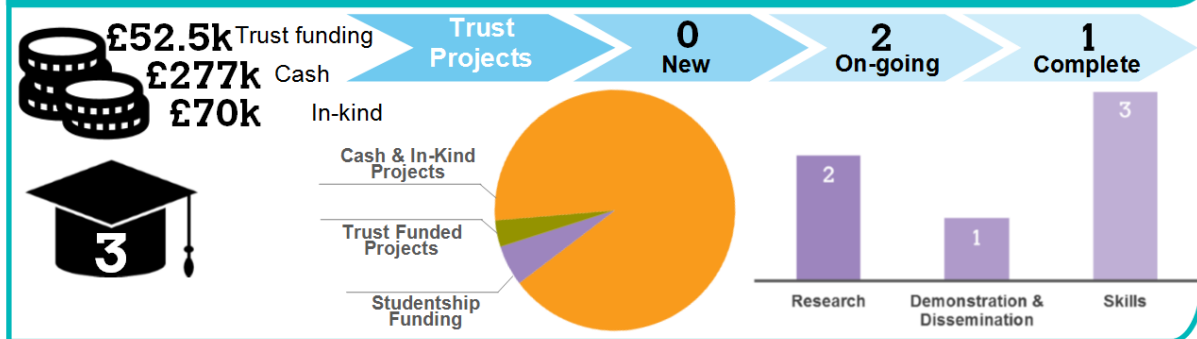
The annual review of the Centre for fire engineering at the University of Edinburgh.

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Project Progress – People

The social interaction of citizens with the built environment, exploring health, productivity, safety and wellbeing. Considering the impact of demographic changes and cultural differences on future assets.



Ongoing project

The life-long health effects of poor indoor air quality

£15k Trust, £140k cash contribution

The project

BRE was invited to participate in a Working Party – Chaired by the Royal College of Paediatricians and Child Health (RCPCH) and the Royal College of Physicians (RCP) – to help deliver a report on the effects of poor indoor air quality (IAQ) on infants, children and young people, and the lasting impacts on their health.

There is much to learn about the effects of poor IAQ, such as the physiological effects of lifetime exposure to indoor air pollutants, the effects of poor IAQ on mental health, the financial costs of dealing with these effects, and how building occupants can practicably reduce or prevent exposure to pollutants.

The published report (due in early 2020) will raise awareness of the issues affecting the health of children exposed to indoor air pollution. It will also present evidence-based solutions for improving children's health, reducing the lifetime health effects of childhood exposure to pollution, and mitigating risk as part of housing renovation and planning and building new homes.

Progress

It has been agreed that the RCPCH will have overall responsibility for the project and production of the report, with the Working Party providing advice and carrying out key aspects of the work.

Working Party members will:

- agree the final scope, and review questions and report content,
- raise potential conflicts of interests,
- attend 6-8 working group meetings,
- carry out literature screening and appraisal of the evidence,
- draft key chapters and recommendations.

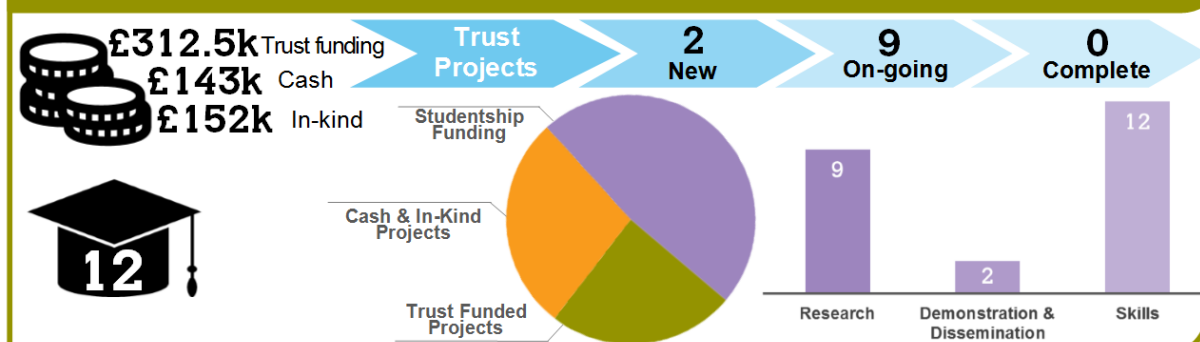
Andy Dengel of BRE is part of the Technical Advisory Group (TAG), which will review and advise on technical aspects of draft chapters for the report.

The TAG participated in reviewing the scope of the project's systematic literature review being funded by Dyson, one of the project partners. The first meeting of the TAG on 16 April 2018 dealt with ratifying the project scope, agreeing the terms of engagement and implementing protocols for the proceedings of Working Party.

As the Working Party proceeds, Andy Dengel will respond to requests for information and will attend meetings as they are convened. The Second Interim Report is due on 30 November 2018.

Project Progress – Property

The delivery of assets which are built and operated efficiently and sustainably, increasing value to businesses who occupy them. Resource efficiency, renewable and efficient energy and adaptability to future changes of use and critical factors.



New Project

Developing performance tests to assess video fire detectors
Briefing paper

£5k Trust

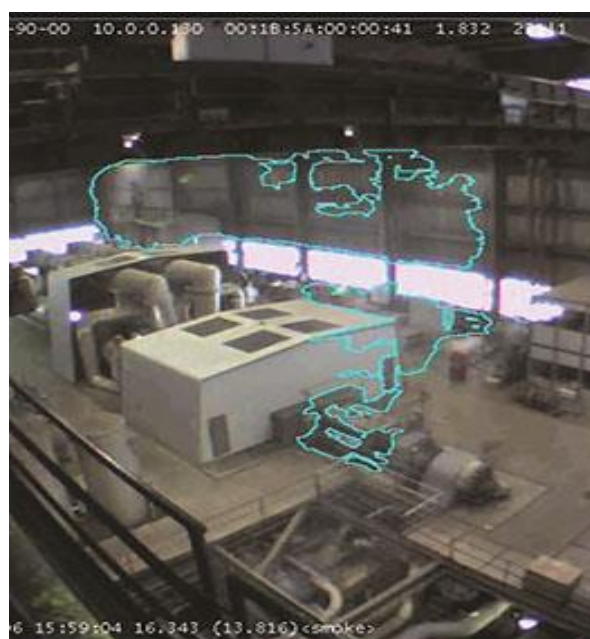
The issue

Research to develop performance tests for assessing video fire detectors, supported by the BRE Trust, the FIA and manufacturers, has been conducted in three phases:

- 1) An investigation of measurement methodology and instrumentation to identify a suitable test method, conducted in the BRE fire test room.
- 2) Fire tests to identify an appropriate operational performance assessment method.
- 3) Final fire tests performed for video smoke detection under controlled and stable conditions.

The project

This project will produce a briefing paper on *The development of performance tests to assess video fire detectors*. It will report to the industry on the research process used in this work, and the tests that have been developed to assess video fire detectors. The paper is due for completion on 30 November 2018.



The benefits

In the UK there are four large manufacturers of video fire detection systems exporting their products around the world. The briefing paper will report on verified test methods that will help those designing and assessing video fire detectors to ensure that their products are robust and reliable. This will contribute to delivering safer buildings as a result of the improved understanding and use of video fire detectors.

Looking ahead, the findings from this project could feed into the development of an LPS standard that, in the absence of a European standard, will be supported by manufacturers.

New Project

Setting standards for IAQ sensors and monitors

£50k Trust, £25 In-kind

The issue

While it is often the visible forms of air pollution that grab the news headlines, much of the potential air pollution harm comes from *invisible* pollutants, often at relatively low levels. The harm can be particularly serious in childhood, and then additive over the course of a lifetime.

With increasing public awareness of the links between poor air quality and impacts on building occupants, there is a growing appetite for initiatives to improve indoor air quality (IAQ). The need to ensure health and wellbeing of building occupants, and enhance employee morale, productivity and retention, has also not been lost on the commercial office and retail sectors, and educational and healthcare organisations.

Addressing IAQ requires the continuous monitoring of various parameters. There are increasing numbers of sensors and monitors on or due to be on the market, but the quality of the hardware and resultant data is extremely variable. There is a strong need for robust protocols for testing such devices, to verify that the data obtained are fit for purpose.

The Project

This project will investigate the performance of a range of commercially available VOC and CO₂ sensors/monitors when exposed to pollutants generated in a controlled environmental chamber. Standard (ISO 16000 series) sampling/analytical methodologies or reference analysers will be used for comparison, and issues such as installation, siting, calibration and maintenance of the devices will also be investigated.

This will set the foundations for a robust chamber-test protocol for air quality monitors, which can be applied when developing standards against which such instrumentation may be certified in the future. At the same time, the performance characteristics which should be applied to the devices when specified for use in BREEAM building assessments can be gauged.

This work will be carried out by BRE, using our room-sized environmental chambers, with support from collaborators including IWBI, GBCI, GBCA, Giga and University of Bath – BRE CICM. Final project report including chamber test protocol (and its potential to be used for certification), chamber test results, and recommendations for performance characteristics to be applied in Standards, BREEAM schemes, etc, is due on 31 March 2019.

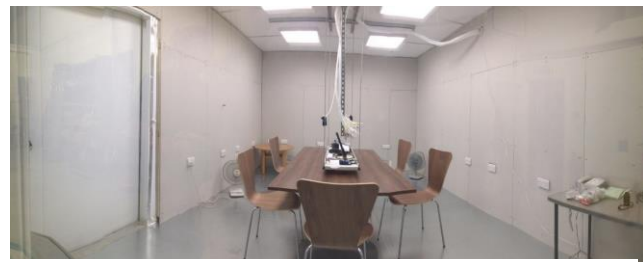


BRE's 30 m³ 'ECO-SEE' environmental chamber (conforms to CEN 16516).

The benefits

This work will help to deliver a better understanding of building performance in use, through specifying the right types of sensor or monitor. Better spaces and better buildings will result from a heightened awareness of the importance of good indoor air quality, with wide ranging benefits to building occupants' health & wellbeing and productivity, and to public health and the UK's health services in general.

Information gained from testing currently available sensors will be used to consider the performance (precision, accuracy, selectivity, repeatability) and operational aspects (installation, calibration, siting, maintenance, data handling) of their use in building performance, and health and wellbeing assessments. It will also be used to feed into a roadmap towards BRE standard(s) for such monitoring devices.



BRE's new 40 m³ occupiable environmental chamber.

On-going Project

Resilience – Tackling overheating in urban dwellings

£35k Trust, £75k cash contribution

The Issue

Overheating is already commonplace in UK homes and climate change is predicted to exacerbate this problem, particularly where the urban heat island effect comes into play, with knock-on impacts on occupants' health.

With concerns that the incidence of overheating will increase, especially in new build dwellings in urban locations, there is the need for monitoring studies in the field to highlight its causes and help in developing ways of preventing overheating.

The project

A case study has been conducted of overheating in apartments in Golders Green, North London in partnership with a large developer. The investigation of several occupied flats with overheating found multiple contributory factors, and led to recommendations for supply chain and other stakeholders in nine areas: heating system primary distribution pipework, HIU controls, MVHRs, removal of heat liberated by pipework, ventilation of flats for temperature control, solar shading, door seals, thermal bridging and balcony security.

A peer-reviewed journal paper has been published on the above case study, in collaboration with Dr Rob McLeod of Loughborough University (Swainson M. and McLeod R. Chronic overheating in low carbon urban developments in a temperate climate. *Renewable and Sustainable Energy Reviews*. 74 (2017) 201–220).

There has been long-term monitoring of a new block of flats in Clapham, South London in collaboration with the Peabody Trust. Wireless monitoring sensors have been embedded throughout one zone of the building.

The next step

A BRE Trust supported PhD student at Loughborough University has recently started work on the next phase of the project, which will examine ways of improving overheating risk assessment procedures in urban dwelling. This will include the monitoring of newly completed urban dwellings to investigate sources of excessive internal heat gains and identify opportunities for reducing overheating risk. BRE will provide access to projects and monitoring equipment of relevant buildings to be investigated.

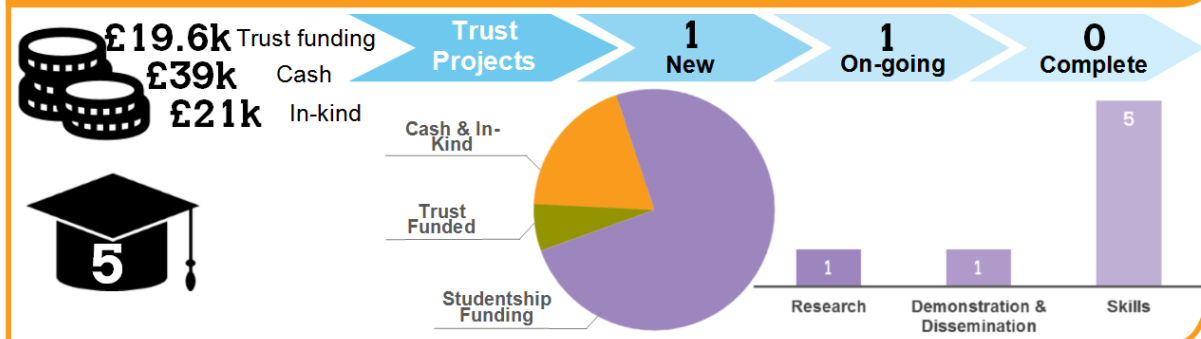
Existing overheating risk assessment methods will be assessed, and proposals developed for new methods enabling more robust risk prediction and assessment. Outputs of this work will include journal and conference publications and dissemination workshops. The work is likely to inform new standards for overheating risk prevention (such as Part L and Part F and CIBSE guides), as well as helping to evolve existing BRE tools and methodologies such as SAP, BREEAM and the Home Quality Mark in relation to modelling and assessing overheating.



The already common problem of overheating in homes will be exacerbated by climate change. The latest stage of this BRE Trust supported project will look at ways of improving overheating risk assessment.

Project Progress – Places

The robustness and resilience of communities and cities to natural and man-made external environmental influences. Climate effects, biodiversity and the interaction between buildings and their surroundings are a priority.



New Project

Creating positive spaces using pre- and post-occupancy evaluation

£7.7 Trust, £15k cash contribution

The issue

With staff costs in office-based businesses typically accounting for 90% of a company's costs, any improvements in employee health or productivity can have massive financial implications. There is now strong evidence for the built environment's impact on staff health, wellbeing and work performance, and a growing focus on health and wellbeing in business and construction.

But most organisations don't carry out workplace performance reviews, and most designers and developers don't gather feedback on their buildings using mechanisms such as pre- and post-occupancy evaluation (PPOE) – so they are unaware of the issues impacting on office workers, or how to address them through office design.

PPOE is a tried and tested means of identifying and addressing these issues in existing buildings or completed new build and refurbishment projects but it is rarely carried out even in a basic way by designers or developers. BRE has considerable technical expertise in the area of social science led occupant consultation and other PPOE methodologies.

The project

Two of BRE's partners in the [Biophilic Office](#) project, Interface and Oliver Heath Design (OHD), are advocating a human-centred design approach to improving living and working spaces and, in turn, the health and wellbeing of staff. They are working on four guides as on human-centred design, aimed at designers, decision makers, end users and influencers in the built environment.

Three of the guides cover the WELL building standard, Biophilic design and Designing for Community. The fourth, and the focus of this project, is the *Guide to creating positive spaces using pre- and post-occupancy evaluation*, on which BRE has been invited to collaborate and provide the technical content.





BRE is working with OHD on the structure and content of the publication and with Interface on marketing the report, which will cover:

- The basics: What is a PPOE?
- The business case for measuring the impact of your design
- Demystifying the PPOE process
- What do I do with all these insights?
- Who's doing it? Case studies
- So, what can I do myself? Getting started with PPOE

The publication 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.

The benefits

This publication will raise awareness amongst building designers and the business community, of the benefits of pre- and post- occupancy evaluation. It will advise on the best ways of creating positive workspaces that benefit occupants and businesses.

The project showcases BRE's technical expertise in PPOE methodologies and research, support's BRE's expertise in health and wellbeing, and promotes other work on sustainability and building performance improvement such as BREEAM.



Pre- and post-occupancy evaluation is an important element BRE's Biophilic Office project to examine how nature-inspired design can foster 'wellness', which has benefitted from BRE Trust support. A suite of offices at BRE's Watford site (part of which shown above left) is being extensively evaluated now, and will be evaluated again after the offices are refurbished in accordance with biophilic principles, using the sort of elements illustrated in the right-hand image above (Image: Oliver Heath Design).

Outreach & Dissemination Activities

2018/19 outreach – June to September 2018

Publications =2 New Articles =47 Events =9 Bookshop Sales=1414 units
 CIS Downloads 58, 5470 DBW downloads 46,465

Sales & Downloads

BRE Bookshop

Customers continue to buy concise guidance on good building practice in core areas, such as building retaining walls and treating damp, as illustrated by the sale of three complete sets of printed Good Repair Guides in this quarter.

Nine DVDs on identifying non-traditional houses in the UK (AP 294) were sold in this quarter. Twenty copies of *Recognizing wood rot and insect damage in buildings* (BR453) were sold through Amazon in a single order in August.

Retail sales this quarter totaled 982, a 16% increase compared to the last quarter (827).

Construction Information Service (CIS)

Here is a list of the top 5 BRE titles downloaded in the last quarter:

1. *Soils, ground investigation and foundations – a collection of BRE expert guidance* – 533 downloads.
2. *Soakaway design*. 2016 Ed – 393 downloads.
3. *Concrete in aggressive ground* – 375 downloads.
4. *Radon: guidance on protective measures for new buildings* – 302 downloads.
5. *Fire safety in buildings - a collection of BRE expert guidance* – 267 downloads.

The total number of downloads in this quarter was 30,057, which is 10% less than the last quarter (33,207) and 16% lower than the same time last year.

Whilst BRE is the 2nd most popular author on CIS the download figures continue to fall year on year. Other platforms and partnership approaches are being developed to counteract this and ensure that the BRE Trust extends, not contracts its outreach.

Designing Buildings Wiki

BRE articles

By the end of the quarter, there were 332 BRE articles on Designing Buildings Wiki. These can be seen at:

www.designingbuildings.co.uk/wiki/BRE_articles_on_Designing_Buildings_Wiki

This content was viewed 21,089 times during the quarter compared with 25,376 last quarter, and the top 5 BRE articles were:

- BREEAM (1,950 views).
- BRE Digest 365 Soakaway design (1,061 views).
- The daylight factor (695 views).
- Fire performance of external thermal insulation for walls of multi-storey buildings, third edition (BR 135) (650 views).
- Automatic fire detection and alarm systems, an introductory guide to components and systems BR 510 (536 views).

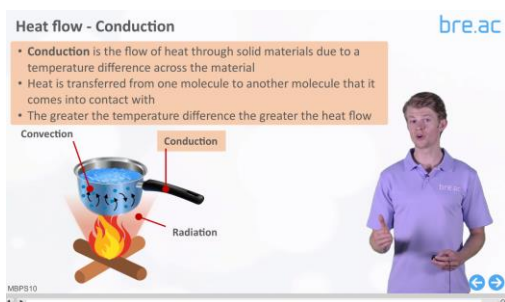
BRE has used this platform as a dissemination platform for the last 4 years and since then its growth and outreach has extended considerably. This is very encouraging and a demonstration of the value that an increasing number of authors are placing in the platform.

By the end of this quarter there were 7,344 articles, and the site was visited 1,430,464 unique users. It also received 3,605,524 page views, a 50% increase compared to the previous year, BRE are working with Gregor Harvey, the founder of the platform and other key supporters to understand the analytics and use and preference which is now being generated.

BRE Academy

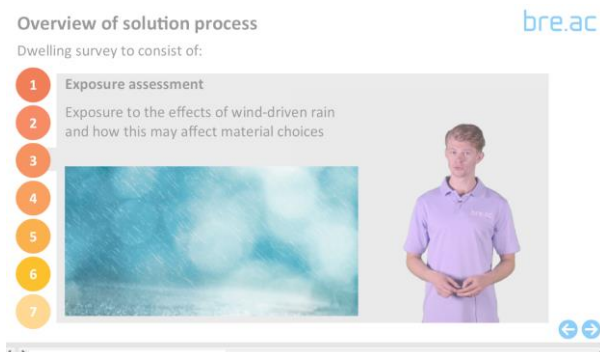
Retrofit training

The Each Home Counts (EHC) review looked at the domestic retrofit market in light of the challenges around delivering Green Deal and concerns about installation quality. It made recommendations to protect householders and increase their confidence in the refurbishment market. These included introducing a quality mark and supporting technical codes of practice and standards to cover the design and installation of energy efficiency measures and renewable energy systems.



BRE Trust funded training

Key to this is upskilling and training those delivering such installations. The BRE Trust has funded BRE Academy to develop a series of 20-30 minute awareness-raising on-line modules on a series of retrofit issues. These are focussed on those surveying properties and designing energy efficiency measures. Prepared by BRE experts and drawing, the modules are being developed by the Academy's Digital team using leading edge software and green screen technology to produce engaging training with interactive content.



The topics are:

- Building physics
- Airtightness
- Unintended consequences

- Applying External Wall Insulation
- Exposure assessment
- Moisture awareness

An introductory module will pull together the separate topics. The intention is to make them available for free or at a nominal cost, which will involve engaging with users and stakeholders to understand who is using the materials, gather feedback and gauge impact.

Retrofit paper for BRE USA

Allied to the retrofit training modules, the Academy has been working with BRE USA to help raise the profile of refurbishment and BRE in the US. They have worked with Gensler, an integrated architecture, design, planning and consulting firm based in San Francisco, to prepare the Gensler Research Institute's 'Integrated by Design' annual publication which in 2018 focusses on resilience and sustainability to design and shape future cities. BRE prepared a paper on the challenge of refurbishing buildings that has been included in the publication. It highlights the importance of existing buildings when considering total CO₂ emissions, and summarises policies in the US and Europe and their impact on targeting retrofit and stimulating significant emission reductions.

Greater University engagement

As reported in a previous Trust report (Q3 17/18), BRE is partnering with the University of Herts to deliver a Civil Engineering degree (BEng/MEng), and also Oaklands college its BSc Construction Management. In both cases students come to BRE to undertake laboratory preparation and testing of timber and steel, and have lectures on timber, BIM, BREEAM and CEEQUAL. This is continuing, but we are also seeing more universities seeking tours of the Innovation Park, practical demonstrations (e.g. airtightness tests) and lectures (e.g. flood, passivhaus etc).

Our engagement with the academic sector is also developing through increased uptake of our BREEAM and BIM AG (Approved Graduate) programmes, where construction students learn about sustainability/BREEAM and BIM respectively to help prepare them for their future careers. For example, we are working with Cardiff University on their new BIM MSc at the end of which students can be certified as informed professionals.

We are also looking to offer these and other programmes internationally, and are in discussion with universities in Russia and Brazil.

Media articles

The Biophilic Office project, in which a suite of offices at BRE's Watford campus is being refurbished in accordance with biophilic principles, has attracted considerable media attention.

The BRE Trust has provided dissemination support for the project, and the Trust's secretariat is continuing to help the project by producing articles for various publications. These include the RICS Building Control Journal, the CIBSE Journal publication and the India-based Architecture Update.

Events

Behaviours & Psychology, Business Models and Collaborative Innovation

The Constructing Excellence Autumn Members Forum on 14 September focused on the research, innovation and skills needed to help deliver positive disruption in the construction industry. Speakers included Jon de Souza, Chair of the Research, Innovation & Skills Theme Group which has asked members to identify where further research, innovation and skills were needed.

The key areas discussed – all of which are aligned with the BRE Trust's productivity challenge – were:

Behaviours & Psychology

Many problems affecting the construction industry are driven by cultures and behaviours.

From standardisation of contract and procurement processes to truly procuring for value, it boils down to engendering a culture of respect across the industry. The group proposed researching what is happening in other countries and industry sectors which have more open and transparent cultures and behaviours.

Business Models

The group discussed how the industry can really embrace digital technology and manufacturing principles to drive a new, fairer and more sustainable business models. It proposed working with business schools to look at the benefits and risks associated with new business models.

Innovation at an industry level

The construction sector is described as having low rates of innovation. However, innovation happens at a project level rather than through central R&D departments and is therefore difficult to capture and share and does not deliver on its full potential. There is a need for a cultural change at all levels of the industry to make sharing the norm.

Next steps

The group is planning a workshop in early 2019 bringing together industry and academic experts from within and outside construction specialisms to explore what research, innovation and skills are needed to drive change around behaviours and psychology across the sector. This will be followed by a session on business models later in the year. The core group will be meeting in the meantime to shape these workshops and ensure maximum exposure.



ECI roundtable

The European Construction Institute (ECI) became part of BRE, alongside Constructing Excellence, in September 2017. Its mission is to drive project execution and delivery best practice across the international engineering construction sector, through its regional centres in the UK, Italy and Benelux.

On 2 October a roundtable of owner operators and investors in the engineering construction sector was facilitated by ECI and McKinsey, and hosted at Shell's headquarters in The Hague.

“Surviving and prospering after the *Perfect Storm*: Challenges in delivering capital projects”

In 2015-16 the ECI published the report It identified the key issues affecting the use of capital:

- failings on mega projects,
- poor performance, productivity and HSE,
- inadequate innovation,
- insufficient integration, collaboration and early supply chain involvement.

What's changed?

- The roundtable discussed what has changed in the last 2-3 years, and what different approaches might be needed to make a difference for owners and operators.
- Capital efficiency and the need to work together better as a sector to address it, remains the number one issue for clients. The discussion identified a number of familiar

themes for improvement, which require a clear road map to go from today to a different way of working. A key ECI will focus on producing this map, which may be a project in which the BRE Trust would wish to take an interest.

- In addition, new research will consider mathematical models – the BRE Trust may see value in working with ECI on commissioning this as it has direct relevance to the infrastructure section.

Women in Construction

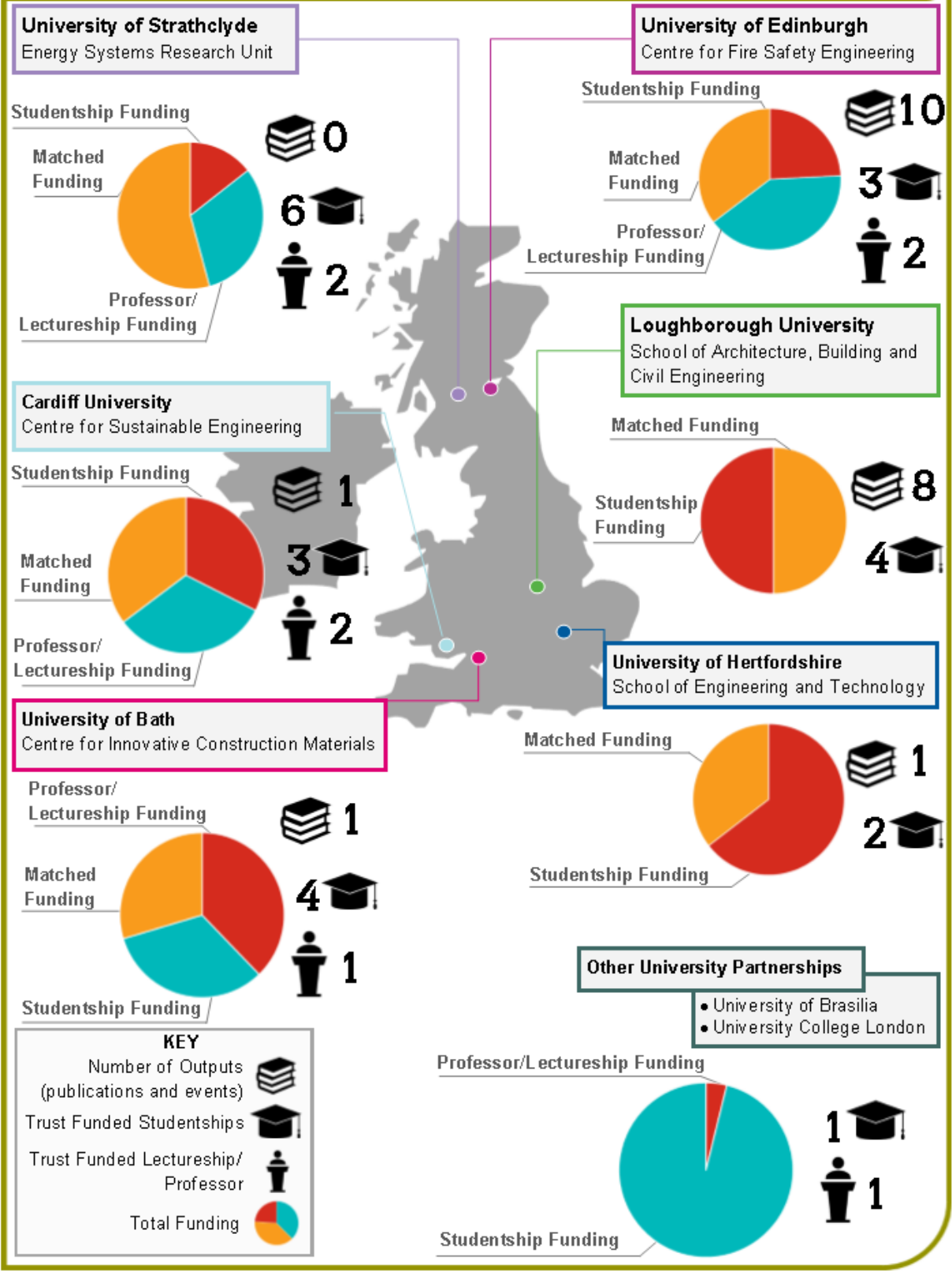
The Constructing Excellence leaders breakfast meeting on 18 September looked at the issue of Women in Construction. It included input from Amanda Fisher MD, Defence & Justice at Amey, Kate Hall, Design Director at HS2, Briony Coombs, Site Engineer at Balfour Beatty and Sophie Gowland, Assistant Quantity Surveyor at Blu3.

The group debated the change needed in the sector to get more women into leadership positions. Constructing Excellence will coordinate a follow-up task-finish group to advance this issue in collaboration with Balfour Beatty. The remaining programme for 2018 is as follows:

- 15 November – Steve Rowsell – How can good procurement ensure better value.
- TBC - Sir Graham Brady (Chairman of 1922 Committee, MP for Altrincham) – Is UK politics, investment and society too London centric?



University Summary Q2 2018/19



Partnership Programme

Total funding Committed 2018/19 = £362k

Funding available £138k

No. professors/lecturers supported = 4

No. active Students = 27

No. students completed 2018/19 = 1

No. new students 2018 = 6

Partnership building at UC Davis

An important element of BRE Trust strategy is the development of research and dissemination collaborations, establishment of key areas of work, and further positioning of the BRE Group and its products and services, in the American built environment sector.

As part of this, the group of BRE leaders and specialists pictured below spent a number of days at the University of California's Davis campus (UC Davis) in September 2018, to investigate potential collaborative projects and shared learning opportunities.

Of particular interest was working with the UC Davis Western Cooling Efficiency Center and the California Lighting and Technology Center. These two research institutes work, as does the BRE Trust, in collaboration with numerous partners, focusing on technological development and performance improvement as well as social and political aspects.

A series of well attended workshops allowed UC Davis and BRE to share insights into current

programmes and discuss areas where natural synergies between our work exist. A number of diverse research and collaborative activities were highlighted, including climate-based fuel poverty, energy/light modelling versus recorded data analysis, the application of Innovation Park models and light-related impacts on performance and productivity.

Discussions with campus facilities managers gave insights into the innovative programmes implemented by the UC Davis Energy Conservation Office to improve sustainable practices across the campus. Using web-based apps and sensor monitoring, the team has developed a number of ways of engaging the community (students and public alike) in energy-efficiency-driving tools. This provided inspiration for how BRE, on a much small scale, could look to improve our on-site monitoring, management and engagement.

The successful trip concluded with a number of projects already drafted, and subsequent conversations have helped to further develop these proposals.



The BRE Team at UC Davis: Cosmin Ticleanu (Lighting and indoor environments), Harriet Cooper (Research and Innovation Consultant), Deborah Pullen (Knowledge transfer and teaching opportunities), Josh Morejohn of UC Davis, David Kelly (Innovation demonstration and whole building monitoring), Lori McElroy (Energy modelling and energy systems), and James Fisher (Regulation and standards - BREEM).

Article 25 lectures

Make design matter

Part of the BRE Trust's ongoing partnership with [Article 25](#) – a UK registered charity that manages sustainable architecture projects in areas of extreme poverty and disaster the – Trust is supporting a series of Article 25 lectures titled 'Make Design Matter'. These free talks bring together experts in humanitarian design, planning and architecture to inspire others through examples of positive and sustainable building design.

Each talk includes project case studies as well as panel discussions, highlighting prevalent topics in the humanitarian construction sector and the variety of form building design for international development can take.

Sustainable maternity facility

The first talk in this series took place in October, focusing on a project delivered by HKS architects in Kachumbala, Uganda. The design of a sustainable, passive maternity facility, built in collaboration with other humanitarian actors helped create a much needed facility that was appropriate to the community and climate. In November the second lecture will focus on public meeting areas for rural communities, as demonstrated by a pavilion and community centre in Okana, Kenya.

Dementia friendly home update

BRE, Loughborough University and Liverpool John Moores University have announced that phase one of the refurbishment of the Dementia-friendly demonstration home on the BRE Innovation Park has been completed.

Launched in July (as reported in Q1 2018) and now open for visitors, the building has been adapted to help housebuilders, carers and relatives to better support those living with dementia, using design principles that will help them live in their homes for longer.

The BRE Trust has provided funding for the project to support information gathering and stakeholder engagement tasks. We will report further on this project in the next Review.

Studentship Programme

There are currently 21 active PhD studentships including 4 newly approved studentships in this quarter. The BRE Trust has committed £407k to the programme so far this year.

New Studentships

Blockchains for traceability assurance, Alastair Marsh, [Loughborough University](#), Trust Contribution - £30k

The issue

There is growing interest in being able to track and trace construction products – and the information about them – through global and complex supply chains. But the literature on traceability is varied, imprecise and confused.

Blockchain technology (BCT) is a potential solution to this problem. Blockchains are customised transaction exchange mechanisms that are secure and cannot be changed or tampered with. BCT could provide accurate and reliable information on the origins and history of construction products. Someone concerned for example with combatting modern slavery, could assure potentially themselves that a product was not tainted in that way at any point.

The project

A BRE Trust funded study has already identified the potential for BCT. There is now a need to build on this theoretical work on traceability. This student will investigate the possible applications of BCT. As part of this, selected BRE products and services – such as BREEAM and Red Book certification – will be used as case studies to examine the practicalities and potential for applying BCT.

Building Energy and Environment: measurement, data, analysis and interpretation, Daniel Frank, [Loughborough University](#), Trust Contribution - £30k

This study of the energy demands for heating in homes in England is in two phases, an MRes degree, followed by a PhD.

The MRes dissertation includes a literature review and exploratory work to investigate what can be achieved with advanced analytical methods. For example, is it possible to identify appliances contributing most to electricity demand, or to accurately reconstruct the patterns of heating in homes? Also, does the information found conform to the established understanding of these matters?

The PhD phase will seek an understanding of what causes high energy demand – and separate the effect of the building (house type, geometry and energy efficiency) from socio-economic factors – and to understand how patterns of demand have changed since 2011.

The principle aim will be to understand the change over time of energy demand and temperatures in English homes, and the changes in the socio-economic status of households and how these interact to produce high energy demand and/or fuel poverty.

Developing a Fire Robustness Assessment Index for the Built Environment, Vasileios Koutsomarkos University of Edinburgh, Trust Contribution: £78k

The aim

This project aims to create a sustainable framework that will allow designers to go beyond compliance and achieve a higher standard of fire safety than is required by legislation.

This could ultimately help to incentivise good industry behaviours in terms of workmanship and resilience planning, and develop a viable business related to the BRE resilience framework.

The project

BRE wants to create a methodology to categorise and identify improvements to building based on their resilience to fire events. This project to support that methodology will:

- Capture and refine (or propose) an overarching framework for the Fire Resilience Assessment Methodology.
- Conduct a gap analysis of the areas of knowledge required to support and implement the overarching framework.
- Investigate the most critical knowledge areas required to support the implementation of the Fire Resilience Assessment Methodology.

As BRE has already consulted extensively on the proposed Fire Resilience Assessment Methodology, the first step will be to capture this consultation and the current thinking at BRE. It is proposed that BRE and the University of Edinburgh will together identify an exemplar project (possibly in consultation with relevant stakeholders) that falls within the scope of the assessment methodology. The student will attempt to implement the methodology and undertake research on the identified knowledge gaps.

Self-healing concrete, Lorena Skevi, University of Bath, Trust Contribution - £65k

The aim

It has been calculated that in the UK the annual cost of repairing our infrastructure (mainly concrete) is £40bn. This project will undertake research into the development of 'smart' cement-based materials, with autonomic self-healing and self-repairing capabilities. It is anticipated that these developments will transform our building materials, enhance durability and serviceability and reduce maintenance costs.

The project

The form of self-healing concrete to be studied involves the use of bacteria that can microbiologically precipitate calcite in cracks. Results of previous research at the University of Bath show that bacteria-based self-healing of mortar is sufficiently effective to return the permeability properties of cracked mortar back to that of uncracked mortar under laboratory conditions.

This research will investigate how to ensure that self-healing occurs in concrete in environments more closely aligned with the conditions that will be present in practice. This will require the use of a range of bacteria and solutions never previously studied.

The opportunities for such materials are enormous as the potential applications range from coatings and DIY products, to buildings, to large scale civil engineering.

University of Edinburgh Centre for Fire Engineering Annual Review



THE UNIVERSITY of EDINBURGH

Centre for Fire Safety Engineering conducts fire science research across a broad range of topics. The combination of expertise in the behaviour of structures in fire with that of fire dynamics gives the Centre a unique research strength worldwide. Its knowledge, skills and competence are used to address issues related to the modern built environment (e.g. high-rise fire safety), infrastructure (e.g. tunnels), socio-economic problems (e.g. fires in informal settlements), and global fire problems (e.g. wildfires).

The BRE Chair of Fire Safety Engineering is held by Professor Grunde Jomaas, and Dr Angus Law is the BRE Lecturer in Fire Safety Engineering. In addition to its 9 academic staff, the Centre normally has more than 20 PhD students in fire safety engineering and 5-10 post-doctoral researchers and staff members. The Centre produced 44 ISI (International Scientific Indexing) indexed publication in the last financial year.

On 23 October a BRE team including Deborah Pullen and Debbie Smith (MD of BRE Global) and Roger Harrison (Technical Director for Fire safety engineering at BRE) visited the Centre. They met with, among others, Professor Jomaas, Dr Law and Prof Conchúr Ó Brádaigh, Head of the School of Engineering, for wide ranging discussions which included issues such as:

- The BRE Trust's updated strategy, operations, funding structures, and way of increasing the Trust's outreach and impact in the Fire and Safety department of the Engineering school.
- The increasing number of the international students joining the centre, indicating an increase in the outreach of fire safety subjects.
- The progress related to the planned MEng degree in Fire safety engineering.



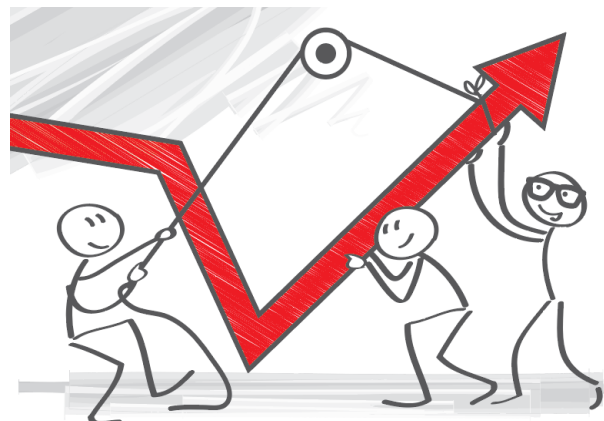
Highlights from the past year

Professor Jomaas gave a presentation on the past year's highlights, a small selection of which includes:

Inaugural lecture – in November 2017 Professor Jomaas gave his inaugural lecture on Parabolic Flights.

This included a history of oxidation processes from the Phlogiston Theory to flammability experiments in outer space. He introduced interesting aspects related to and results from experiments carried out in parabolic flights (low gravity) and on board the Cygnus resupply spacecraft while orbiting Earth (microgravity). The latter is part of the SAFFIRE project, which is driven by NASA (<https://www.nasa.gov/saffire>).

New PhD studentship – Economic and Social Research Council Collaborative Studentship, with co-funding from Camden Council on *Fire Safety in Practice: Making Residents Safe in Camden Council*. Working in close cooperation with Camden Council, the student will investigate how to address concerns about fire safety in social housing following the Grenfell Tower fire, and fulfil the promise of Camden Council leader Georgia Gould for: 'A more thorough and transparent approach to fire safety that fully involves our residents'.



Wildfire experiments in New Jersey, USA – researchers from the Fire Group are involved in two projects on wildland fire led by Dr Rory Hadden (Rushbrook Senior Lecturer in Fire Investigation). Both projects involve the US Department of Agriculture (US Forest Service) and a number of academic partners. The Strategic Environmental Development and Research Programme-funded project seeks to understand the spread of low-intensity fires as typically used by land managers to control the amount of vegetation and reduce the risk of large wildfires.

The second project is funded by the Joint Fire Science Programme (JFSP) and is aimed at understanding the generation and deposition of firebrands and their role in the ignition of structures at the wildland-urban interface.

Improving fire resilience of informal settlements – funding was successfully secured for *Improving the Resilience of Informal Settlements to Fire*, a high-impact project on how an interdisciplinary approach to fire science and engineering can improve the resilience of informal settlements against fires.

The PI for the project is Dr David Rush, and the project partner in South Africa is Stellenbosch University. Through a combination of state-of-the-art experimental and modelling fire science coupled with unique data gathering in informal settlements and novel applications of existing satellite data, the project will deliver a framework to assess fire risk in informal settlements and propose technologically appropriate, data driven risk reduction methodologies.

Travel Award winning visitor – Ian Pope, a Peter Gadsden Travel Award winning student, visited for part of the year from the University of Queensland. During his exchange experience at the university, he gave presentations on bamboo and work on condensed-phase temperature measurements and experimental uncertainty.



Wildfire experiments in New Jersey.



Fire resilience in informal settlements.



Above: Ian presenting to members of the Hazelab Group at Imperial Collage London



Left: Ian receiving the Sir Peter Gadsden Britain Australia Award from the Master of the Worshipful Company of Engineers and Lady Gadsden (Photograph courtesy of Mark Whitter Photography)

Appendix A: Active Project Status

People

Research

- The use of innovative solutions and digital technologies to increase safety and wellbeing of people and protect them from the dangers of fire. **Trust Contribution** - £12.5k. **Other Contribution** - £50k. **Status** – In Progress
- Life-long health effects of poor indoor air quality. **Trust Contribution** - £15k. **Other Contribution** - £140k. **Status** – In Progress
- Measuring dementia home adaptation, **Trust Contribution** - £30k. **Other Contribution** - £75k. **Status** – In Progress

Property

Research

- Suppression of Biomass Fires. **Trust Contribution** - £5k. **Other Contribution** - £40k. **Status** – In Progress
- Centre for Smart Homes. **Trust Contribution** - £53.6k. **Other Contribution** - £63.5k. **Status** – In Progress
- Circadian lighting effects on health and wellbeing & Solar shading. **Trust Contribution** - £35k. **Other Contribution** - £45k. **Status** – In Progress
- Resilience - Tackling overheating in urban dwellings. **Trust Contribution** - £40k. **Status** – Postponed until January 2019
- Optimum replacement of detectors. **Trust Contribution** - £30k. **Other Contribution** - £37.5k. **Status** – In Progress
- Lancaster Grange: Living Legacy. **Trust Contribution** - £15k. **Other Contribution** - £25k. **Status** – In Progress
- Investigation of the use of TGA for fingerprinting analysis on insulating foams. **Trust Contribution** - £12.5k. **Other Contribution** - £3.5k. **Status** – In Progress
- Setting standards for IAQ sensors and monitors. **Trust Contribution** - £50k. **Other Contribution** - £25k. **Status** – In Progress

Demonstration & Dissemination

- BIM Case Studies. **Trust Contribution** - £24k. **Other Contribution** - £46k. **Status** – In Progress
- Contribution to the “Guide to creating Positive spaces using pre and Post Occupancy Evaluation”. **Trust Contribution** - £7.7k. **Other Contribution** - £15k. **Status** – In Progress
- The development of performance tests to assess fire detectors video. **Trust Contribution** - £5k. **Status** – In Progress **Contribution** - £2k. **Status** – In Progress
- “Specifying timber for healthy buildings” TRADA Wood Information Sheet. **Trust Contribution** - £5.2k. **Other Contribution** - £2k. **Status** – In Progress

Skills & Learning

- Disseminating knowledge through digital training. **Trust Contribution** - £40k. **Other Contribution** - £20k. **Status** – In Progress

Places

Demonstration & Dissemination

- Building Resilience to Natural Disasters. **Trust Contribution** - £12k. **Other Contribution** - £145k. **Status** – In Progress
- Scoping Social Value. **Trust Contribution** - £20k. **Other Contribution** - £15k. **Status** – In Progress

Appendix B: Current Studentships

People (Health, productivity, safety and wellbeing)
Hybrid coupled modelling of heat and smoke movement through complex buildings, Ben Ralph, University of Edinburgh
Modelling indoor environmental quality in low energy housing, Maria del Carmen Bocanegra-Yanez, University of Strathclyde
Measuring and modelling overheating in domestic buildings, Kostas Mourkos, University of Loughborough
Places (community resilience, climate affects)
Social innovation systems for building resilient communities, Donagh Horgan, University of Strathclyde
Holistic and semantic decision and policy-making model for resilient and sustainable urban infrastructures, Giulia Cerè, Cardiff University
Development strategies for future cities to ensure energy resilience, Ciaran Higgins (Part-time), University of Strathclyde
Eco-cities – Towards energy positive districts enabled by BIM Level 3 Semantics, Corentin Kuster, Cardiff University
Future City Transport Strategy Development, Konstantina Bimpou, University of Strathclyde
Testing for knowledge: Maximising information obtained from Fire Tests, using machine learning techniques, Arjan Dexters, University of Edinburgh
Improving overheating risk assessment procedures in urban dwellings – Student TBC – Loughborough University
Property (efficiently and sustainably, resource efficiency, further proof, house quality)
Low cost approach for characterization of Residential Building stock for energy labelling, Ioanna Vrachimi, University of Strathclyde
Bringing big data into building energy modelling - building energy focused geodemographic classification, Steven Zhang, Loughborough University
Dynamic energy analysis for the built environment, Valentina Bonetti, University of Strathclyde
Ignition of solid fuels exposed to transient incident heat fluxes, Simon Santamaria, University of Edinburgh
Embedding a circular economy in the building sector, Katherine Adams, Loughborough University
Traceability in the construction supply chain (productivity), Asselya Katenbayeva, Loughborough University
Flood resilience: Improving building drying times, Fiona Gleed, University of Bath
Real-time and semantic energy management across buildings in a district configuration, Jonathan Reynolds, Cardiff University
Smart Meter Data Analytics for Efficient Energy Management, Anthimos Ioannidis, University of Hertfordshire
Whole-Timber Structural Systems, Aurimas Bukauskas, University of Bath
Next generation natural fibre reinforced geopolymers, James Bradford, University of Bath
Optimising phase change material use for energy- efficient buildings, Ahmad Wadee, University of Bath
Automatic Generation of BIM Models by Semantisation of Building Data, an application in the energy retrofitting domain, Matthew Courtney, Cardiff University
Building Energy and Environment: measurement, data, analysis and interpretation – Student TBC – Loughborough University
Calcined clays as a reactive alternative to fly ash as a binder in Portland cement concrete – Student TBC – Coventry University
Blockchains for traceability assurance – Alastair Marsh – Loughborough University
Developing a Fire Resilience Assessment Methodology for the Built Environment - Vasileios Koutsomarkos

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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.