

# **BRE Trust Quarterly Review July - September 2019**

Prepared by the BRE Trust Secretariat



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# Summary of this report

This report presents highlights from the research, education and dissemination activities supported by the BRE Trust during July to September 2019. It also includes the third in a series of reviews of key work areas, this time covering the topic of indoor environments.

**Indoor environments** – The consequences of poor indoor air quality, lighting, acoustics, thermal comfort and other factors, can range from discomfort and irritation to more serious health effects, both physical and mental. A selection of BRE Trust supported research and dissemination projects in this area are summarised.

**Humanitarian sector update** – The Trust has a growing and fruitful relationship with several partners in the humanitarian sector, particularly those involved in the development and use of QSAND.

**The Construction Knowledge Task Group (CKTG)** – The CKTG was created in 2018 following an industry workshop at which more than 20 organisations expressed an interest in making construction knowledge smarter.

## Research project reports

**Retrofit training modules.** A series of training videos to raise awareness of key technical refurbishment topics – aimed at surveyors, designers and other involved in domestic refurbishment projects – is now available.

**Applying SDGs in infrastructure projects.** This research aimed to provide knowledge of which SDG targets apply to infrastructure projects, raise awareness across the industry, and enable BRE to understand how CEEQUAL and other products might need to evolve.

**Adapting homes for dementia.** This project has developed a method of assessing the effectiveness of measures taken to create supportive environments for those with dementia.

## University Partnerships

**Quarterly reports** from the University of Bath Centre for Innovative Construction Materials and the University of Edinburgh Centre for Fire Safety Engineering.

## PhD studentship updates:

- Donagh Horgan, Strathclyde University – *Innovations systems for buildings resilient communities.*
- Ioanna Vrachimi, Strathclyde University – *Characterising building stock for energy labelling.*
- Alistair Wilson, Loughborough University – *Study of the potential of distributed ledger technologies to improve traceability assurance in the construction industry.*

## Regular reports

**Sales and downloads** – updates from the BRE Bookshop and Construction Information Service (CIS). Retail sales totalled 507 units including 146 through IHS retail. CIS downloads totalled 27,770.

**Designing Building Wiki** – updates on general performance, BRE articles and BREEAM Wiki. There were 421 BRE articles on Designing Buildings Wiki, the contents of which have been viewed 32,784 times.

## Events and Publications:

- QSAND stakeholder workshop – was held in September 2019 to review the BRE Trust's engagement opportunities with the humanitarian and development sectors.

- Building of the future – the BRE Trust hosted the five winners of the UCEM 'Building of the Future' competition for a day of activities at BRE's Watford site.

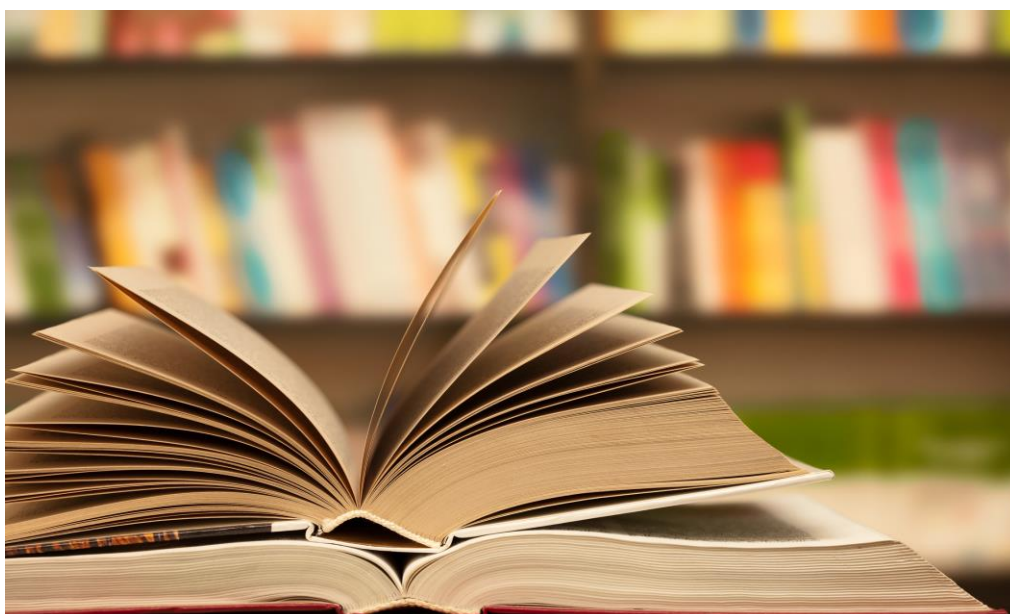
- *Lighting for circadian rhythms* – a new BRE Trust report providing full details of the findings of a Trust supported research project to assess circadian lighting.

- The BRE Trust Knowledge Hub – went live over the summer at [www.bretrust.org.uk/knowledgehub](http://www.bretrust.org.uk/knowledgehub).

- Improving waste management with BIM – Research exploring the potential of applying BIM to improving operational waste management in buildings – in a project supported by the WCC Research Award 2018 – is presented in a new video.

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# Indoor Environments review

A review of completed and ongoing indoor environment projects, their impacts and dissemination.

**There is mounting evidence for the impact that indoor environments have on our health, wellbeing, performance and productivity. With 65% of the developing world and 85% of the developed world predicted to be living in urban areas by 2050, providing good quality indoor environments is a growing priority – particularly for those developing, designing and operating buildings.**

The consequences of poor indoor conditions can range from discomfort and irritation to more serious health effects, both physical and mental. Important factors affecting indoor environments include indoor air quality, lighting, acoustics and thermal comfort, along with often occurring combinations of these and additional, less tangible factors.

The BRE Trust has supported a wide range of research and dissemination projects to address these issues, a selection of which are summarised in this report.

## BRE Trust Supported Projects

### Assessing 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 such devices are needed.**



IAQ sensor and monitor performance has been investigated in one of BRE's room-sized environmental chambers - the 30m<sup>3</sup> chamber pictured here.

This BRE Trust supported project investigated the performance of various commercially available VOC and CO<sub>2</sub> sensors/monitors, when challenged by realistic levels of these pollutants generated in a controlled environmental chamber at BRE.

### Test protocol for standards and assessments

A key aim was to set the foundations for a robust chamber-test protocol for air quality monitors, which can be applied when developing standards against which such monitors may be certified in future. At the same time, it will enable BRE to gauge the performance characteristics that should be applied to monitors specified for use, for example, in BREEAM building assessments.

### Actions

The project first identified a range of 'commercial' (i.e. for use on building performance assessment/verification) and 'consumer' (i.e. low-cost monitors, watches, etc.) devices. The team then developed a test protocol using one of BRE's room-sized environmental chambers, designed for testing devices against Standard Methods or fully-fledged reference analysers, when challenged by real-life levels of CO<sub>2</sub> and VOCs. This protocol was then used to test some of the devices currently available on the market.

### Findings

A number of the devices with CO<sub>2</sub> sensors performed satisfactorily, as perhaps might be expected given the length of time this type of sensor has been commercially available. However, at normal background CO<sub>2</sub> levels some of the devices over-measured, and at higher levels (1000-2000 ppm) two types of sensor under-measured by 60-80%.

Several of the devices with TVOC (total VOC) sensors performed unsatisfactorily – with many significantly over-measuring TVOC when at 'background' chamber conditions, and having very varied responses to higher concentrations. During the project issues with reliability, reproducibility (although only studied here with two replicate devices), connectivity and procurement were also encountered.

## Impacts

It is anticipated the findings of this project will heighten awareness of the importance of obtaining good data from air quality monitors – especially where that data may be used to inform financial, reputational or personnel-based decisions.

This limited study has shown that more work is needed to assess the selectivity, accuracy, reproducibility and usability of air quality sensors, which might be used to assess the performance of buildings or to garner credits for environmental assessment schemes. It has helped to underline the very real need for Standard(s) for such air quality monitors.

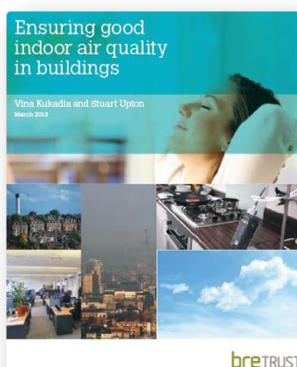
## Next steps

A proposal for developing a BRE Standard for air quality sensors will be submitted to the appropriate BRE teams. The test protocol developed for this project may later be applied to other IEQ parameters such as humidity, CO, NO<sub>x</sub> and particulate matter. The main findings will also be shared with the BRE Centre for Intelligent Homes team, in connection with their work on Smart buildings.

## Indoor air quality

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 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.



## Impact on BRE's business

Indoor air quality is a key area of testing, advisory and research work in the BRE Fire Building Technology Group, and an increasingly important issue in BREEAM.

The project further proved the worth and versatility of the 30m<sup>3</sup> environmental chamber, which is equipped with pollutant source control.

The project work has added to the skillsets and experience of the BRE IAQ team with respect to experimental design and application of existing instrumentation and facilities.

The Intellectual Property generated will be fed into the process of establishing a BRE Standard.

## Lighting for circadian rhythms

**A study of 23 people working in an open-plan office has been carried out by research scientists at BRE – with BRE Trust funding support – to translate experimental knowledge about the effects of lighting in the workplace into real-world good practice.**

## Circadian rhythms

Circadian rhythms control human alertness and sleep, and the release of hormones. Daytime exposure to light, especially blue light, helps synchronise the circadian clock, enabling us to feel alert during the day and sleepy at night. But many people work in poorly daylight spaces with relatively low levels of electric light, where it may be hard for their bodies to maintain their circadian rhythms.

Dynamic 'circadian' lighting is being marketed using dimmable, colour-tuning LEDs to give brighter, bluer light in the middle of the day, and dimmer light – with less blue – later in the day when it is time to relax. However, little or no research has been done on the best way to control this tuneable lighting under real-world conditions. Research was needed to help translate experimental knowledge into practice and investigate the effects of dynamic lighting and its timing on how people feel (i.e. their subjective assessments), and their activities and reported sleep.



### Lighting conditions investigated

This research took the form of a BRE field study, with 23 participants working in an open plan office at the University of East Anglia. Four conditions were administered over several weeks during winter months:

**Condition 1 – Old constant fluorescent lighting** – i.e., the office’s existing lighting – from 19 February to 2 March 2018.

**Condition 2 – New dynamic LED system** – with **variable** LED lighting at a **lower** level – from 12-23 March 2018.

**Condition 3 – New dynamic LED system** – with **variable** LED lighting at a **higher** level – from 12-23 November 2018.

**Condition 4 – New dynamic LED system** – set up to provide **constant** lighting – from 3-14 December 2018.

### Factors measured

Site measurements, lighting monitoring and computer modelling were combined with subjective and objective measures of performance – including questionnaires, regular pop-up questions and computer-based performance tests – along with the monitoring of light exposure and level of activity of participants using activity tracking watches.

The responses of the participants to questions and computer-based tests were assessed to identify links between key participant performance indicators – subjective alertness, reaction time and concentration – and the measurement and calculation results of circadian light metrics for each of the four lighting conditions.

Participant answers to general questionnaires following each lighting condition were also analysed and compared to assess the potential impacts of variable lighting. In addition, these results were correlated with the activity level data and the measurements of the site’s environmental conditions – temperature and relative humidity.

### Impact on BRE’s business

This project has provided fundamental insights into the basic principles of setting appropriate control strategies for circadian lighting so that occupant health and wellbeing are at their optimum across seasons.

It has supported BRE’s Health & Wellbeing growth area with evidence-based knowledge and information. This can be applied in future research and in commercial projects for clients in various sectors including commercial, healthcare, education, housing and industrial.

### Research findings

#### **Greater alertness**

The average scores for subjective alertness were significantly better with the new dynamic LED system (Condition 2), than with the old constant fluorescent lighting (Condition 1). But comparisons of average subjective alertness scores with the LED systems set up to provide variable lighting (Condition 3), and constant lighting (Condition 4), revealed no statistically significant differences.

#### **Extra light not a factor**

Most participants felt more alert under the dynamic LED lighting in Condition 2 compared to the constant fluorescent lighting in Condition 1, but this also happened for the small number of people who received less light in Condition 2. The increase in alertness did not depend significantly on how much extra light people had with the LEDs. All participants received more light in Condition 3 compared to Condition 4, and the increase in light level was much more uniform across participants compared to the first conditions. However, the higher light levels in Condition 3 did not lead to higher scores, on average, for subjective alertness – only half of the participants felt more alert under the dynamic LED lighting (Condition 3).

#### **Other factors not affected**

There were no statistically significant differences in test scores for reaction time and concentration and in sleep metrics between the two conditions tested in each phase of the project.

#### **Preference for dynamic lighting**

In each phase, participants were asked whether they would prefer dynamic or constant lighting. On average, just over half of them preferred dynamic lighting for their office, typically brighter in the morning and following the variation of natural light outdoors throughout the day. Just under one third preferred the constant lighting.

#### **More questions to answer**

Overall, there is still considerable uncertainty about how much light is required for circadian entrainment – i.e. for a person’s circadian rhythm to align with the rhythms of light. People vary in their normal daily routines and in how much daylight they are exposed to. In addition, even in a space with ‘uniform’ electric lighting some people may receive significantly more light into their eyes than others, depending on which way they face.

More research is therefore still needed to understand better the potential impacts of lighting on circadian entrainment and wellbeing in real-life situations, and how to best quantify these in order to produce

clear recommendations and guidelines for lighting than can support healthy circadian rhythms and wellbeing.

### Outputs

The project findings are described in detail in various outputs, including the following publications:

- A BRE Trust report on *Lighting for Circadian Rhythms* (see page 25).
- CIBSE Journal article ([www.cibsejournal.com/technical/evaluating-dynamic-lighting](http://www.cibsejournal.com/technical/evaluating-dynamic-lighting)).
- Draft papers on findings of the field study for publication in *Lighting Research and Technology* scientific journal.
- Design manual for solar shading (BRE Trust Report) and two BRE Information Papers on retrofitting solar shading and control of solar shading (see below).

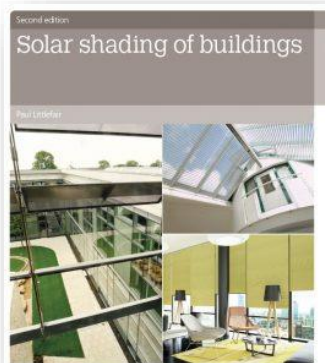
### Solar shading guidance

**One way of providing beneficial circadian lighting is the abundant provision of daylight in buildings – but this can also lead to issues of unwanted solar heat gain and glare unless carefully designed solar shading is provided.**

An additional objective of the *Lighting for circadian rhythms* project summarised above therefore, was to complete the production of BRE guidance documents on solar shading.

### Control of solar shading

A wide range of dynamic shading systems are now available on buildings and the way in which these systems are controlled can have an important impact on building energy efficiency and on occupant comfort and wellbeing. This [Information Paper](#) gives guidance on whether to use automatic or manual control or a mixture of the two; describing control strategies and ways to implement them. This is aimed at building designers, service engineers, shading manufacturers and installers.



### Retrofitting solar shading

Solar shading can have an important benefit on the indoor environment by reducing glare and overheating, and can provide valuable savings in energy.

[This Information Paper](#) describes the shading systems commonly used in retrofit applications and gives guidance on their selection and design. The main beneficiaries of this are building owners looking to make improvements, facilities managers, energy auditors and architects

### Solar shading of buildings: Second edition

Careful choice of solar shading is required in buildings to ensure effective winter solar gain and daylighting without summer overheating. [This report](#) describes the more commonly used shading devices and some new developments; giving the advantages and disadvantages of each kind of shading device. A decision table is included to help find the best solution for a particular building application. The guidance focuses on shading requirements in the UK and in similar climates and latitudes.

### Indoor lighting

The new publication, *Quality indoor lighting for comfort, health, wellbeing and productivity*, provides important information for building designers, owners and occupants – to make them aware of the potential benefits of careful lighting design that meets the recommendations of codes and standards, and ensures that occupants' visual requirements are met. These recommendations address 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 designed or installed to standard recommendations – adversely affecting occupant wellbeing, comfort, health and productivity – the publication recommends specialist post-occupancy evaluation of artificial lighting. It also presents a number of case studies in which lighting problems have been identified and solutions suggested.

## Lighting for circadian rhythms

A new BRE Trust report provides full details of the findings of a Trust supported research project (see page 5) to assess circadian lighting.

Exposure to light is a key factor in maintaining circadian rhythms. A combination of bright light during the day and darkness at night helps to maintain the daily cycle of waking and sleep. Recently, *circadian* lighting, which varies in colour and intensity during the day, has been marketed. The aim is to improve alertness during working hours using bright light, but to switch to lower brightness, warmer coloured light before it is time to relax. This report gives the results of an experiment in a real office situation, to investigate the impact of circadian lighting, and provide guidance to building owners and occupiers, lighting designers, lighting manufacturers and installers. The report can be freely downloaded from the BRE Trust Knowledge Hub.



## Designing for quality indoor environments for occupant health, well-being and productivity

**BRE has used its applied research work on air quality, lighting, acoustics and other aspects of indoor environment quality, to inform its commercial proactive and reactive investigation work in this field.**

To complete this knowledge feedback, findings from such investigations need to be easily accessible industry-wide for new development and refurbishment projects. To this end, the following three guides on the overall theme of 'Quality indoor environments for occupant health, well-being and productivity' have been published – and were launched at the BRE Trust supported *Health, Wellbeing and Productivity: An Integrated Approach to Providing Quality Indoor Environments* event hosted by BRE (see page 10). They are now all available on the BRE Trust [website](#).

## Overheating guidance

**The increased occurrence of heat waves has been widely predicted, exacerbating the already growing number of cases where there is already a build-up of heat within buildings during 'normal' climatic conditions.**

In response to this worsening problem of overheating in certain types of building, two BRE Trust guidance documents – outputs of a Trust funded project by the BRE Building Technology Group and Professor David Ormandy of the University of Warwick – and an academic journal paper have been produced.

The guidance document, *Overheating in dwellings*, was developed to help with assessing homes at risk of overheating, and to inform decisions on preventative measures. The accompanying, *Assessment Protocol*, document describes the assessment methodology and process in detail. The academic journal paper on chronic overheating, was the result of collaboration between BRE's Dr Mich Swainson and Dr Rob McLeod of Loughborough University – *Chronic overheating in low carbon urban developments in a temperate climate*. Renewable and Sustainable Energy Reviews 74, 201-220.



## Creating positive spaces by measuring the impact of design

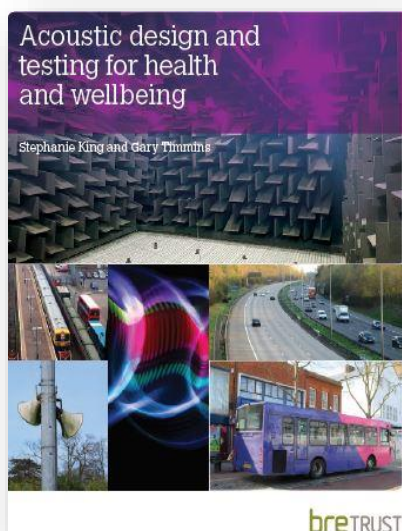
Two of BRE's partners in the [Biophilic Office Project](#) (see below), Interface and Oliver Heath Design (OHD), are working on a series of guides on human-centred design, aimed at designers, decision makers, end users and influencers in the built environment. The first three guides cover the 'WELL' 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 this final publication, which is due to be launched at the end of this year, and with Interface on its marketing. It will be co-badged by BRE, Interface and OHD, and will be distributed internationally in a range of languages.

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



## 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 wellbeing 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)

**In recent years the BRE Trust has supported a number of events designed to showcase and promote the importance of quality indoor environments, and the means of providing these to building occupants. Two events held in 2019 are summarised here.**

## Health, wellbeing and productivity: an integrated approach to providing quality indoor environments

The provision of good quality indoor environments in buildings is essential for occupant health, comfort, wellbeing and productivity. Major building owners and specifiers now increasingly demand high - performance office buildings, recognising that those with high quality indoor environments can command higher rental incomes.

However, there is still a general lack of understanding and knowledge of many of the issues involved, and therefore little guidance on how to achieve such healthy buildings across the whole of the built environment.

An event – *Health, wellbeing and productivity: an integrated approach to providing quality indoor environments* – hosted by BRE and supported by the BRE Trust in February 2019, focused on providing and maintaining quality indoor environments in domestic and non-domestic buildings.

It looked primarily on the key factors - such as air quality, ventilation, lighting, and environmental noise - that must be considered in an integrated manner in order to provide good quality indoor environments.

Three BRE Trust reports on designing for good indoor air quality, lighting and acoustics (see page 9) were launched at the event.

### Wellness and Biophilia Symposium

An outstanding line up of experts in the use of nature-inspired design to foster workplace wellness, including representatives from major companies such as Marks and Spencer and Akzo Nobel, gave presentations and participated in discussion groups and workshops at the Wellness and Biophilia Symposium on 6-7 June 2019.

Hosted by BRE and supported by the BRE Trust, the symposium addressed such questions as, 'How can nature-inspired design foster workplace wellness?' and 'What are the key interventions that can capitalise on the return on investment in refurbishment?' BRE Trust Chief Executive Deborah Pullen gave the opening address to delegates on the Day 2 of the symposium.

The event also marked 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.

The event programme can be viewed and presentations downloaded at: [www.bregroup.com/conferences/biophilia](http://www.bregroup.com/conferences/biophilia).

**The wide ranging BRE Trust supported PhD projects addressing key aspects of the built environment, include the following three examples addressing topics connected with indoor environmental quality, all completed during 2017-19 and briefly summarised here.**

**Konstantinos Mourkos – Increasing the reliability of using dynamic simulation in predicting overheating risk in domestic buildings (Loughborough University); industrial supervisor: Dr Mich Swainson (BRE).**

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.

**Carla da Silva – Interactions between volatile organic compounds and natural building materials (University of Bath); industrial supervisor: Dr Andy Dengel (BRE).**

Key to this project, which formed part of the EU-funded 'ECO-SEE' project led by the University of Bath, was the identification, development and demonstration of low VOC emission materials which have the added benefit of passively improving indoor air quality by capture of VOCs. Carla has since joined the BRE IAQ team, having spent several months of her PhD studies working in its Garston laboratories.

**Andrea Giampiccolo – Development of photocatalytic coatings indoor air quality (University of Bath); industrial supervisor: Dr Julie Bregulla (BRE).**

In this research project several types of photocatalytic particles were synthesised and developed for application to a variety of wood and lime substrates. The doped nanoparticles were investigated in terms of their efficacy for providing photocatalytic reduction of air pollutants in the UV and visible light ranges.

# Humanitarian Sector Update

## Article 25

***The promise of infrastructure: the role of design in an unequal world*, was the last in this year's Make Design Matter series of inspirational talks, organised by humanitarian architecture charity Article 25 with support from the BRE Trust. Held on 26 September, this talk was just the most recent output of the Trust's growing relationship with Article 25 – and with many other partners in the humanitarian sector, particularly those involved in the development and use of QSAND.**

The relationship with Article 25 (A25) dates back to the Trust's sponsorship of BRE's Tim Wiseman to join the Article 25 Cycle Myanmar Expedition in 2017. Visiting numerous rural health centres, the 550km expedition helped to raise research funds, provide expertise on sustainable design, and contribute to research and data gathering. Trust support included funding a local student to take part in the mission, and additional technical input to the review work. Tim Wiseman contributed to the final publication of A25's *Design Guide for Rural Health Centres in Myanmar* available at [www.article-25.org/rural-health-centres](http://www.article-25.org/rural-health-centres).

Article 25 is now organising another cycle ride, scheduled for September 2020, this time looking at improving the design of inclusive schools for disabled children in Tanzania ([www.article-25.org/events/cycle](http://www.article-25.org/events/cycle)). The BRE Trust will help to promote and support this expedition.

### School roof in Burkino Faso

The Trust is collaborating with Article 25 on a research project at a school in Burkina Faso, to assess the effectiveness of a new roof design's impact on the indoor environment. Bath University is also contributing to this project by providing a device to assess the effectiveness of the roof design on the indoor temperature, humidity and airflow. The Trust provided £20k towards developing the assessment tool, with project partners providing an estimated £58k in-kind to the project.

This might lead to further assessment work through Article 25 and others, on buildings that are operating in extreme climatic environments. The outputs could feed into a guidance note on internal environments and thermal comfort, which are currently major issues in the humanitarian and shelter sectors.

Article 25 has visited the school in Burkina Faso to install the monitoring equipment, and will return in the next few months to gather the data and compile the results. There may be an opportunity for the BRE Trust to investigate ways of replicating this kind of monitoring, by making the tool widely available and identifying other potential case studies for trial. The Trust will be working with Article 25 on this issue over the coming months.



Photo: Grant Smith, [www.grant-smith.com](http://www.grant-smith.com)



## Make Design Matter

The Make Design Matter series of monthly talks for the humanitarian sector, led by Article 25 in partnership with the BRE Trust, has brought together outstanding design professionals who work to support the most vulnerable in society across the developing world.

The Trust provided cash support of £10k to this £50k project. Attendance at the talks averaged around 80+ people, mostly students, architects, engineers, and those interested in the humanitarian sector. Following many of the talks, attendees have expressed an interest in supporting Article 25 or getting involved in some way. The BRE Trust has offered to support Article 25 in increasing the follow-up from the talks, either through establishing a network of interested people or a mailing list.

Article 25 is now drawing up plans for another series of talks. The Trust has expressed an interest in providing support, the details of which will be decided when the report on the recently completed talks has been reviewed, and the Trust's future direction with Article 25 planned. A suggestion to link up with professional bodies such as RIBA for future talks has been made, to increase their reach and get more people involved. Videos of some of the talks are available here <https://www.article-25.org/videos>



## Mutual promotion of projects

Article 25 has made significant efforts to align its activities with the UN Sustainable Development Goals, which are also of interest to the BRE Trust (see page 17). The charity will support the Trust in developing materials that link our work to the SDGs. In a similar spirit of co-operation, the Trust has offered to use its network and Knowledge Hub to support dissemination of A25's knowledge and experience.

Article 25 is engaged in humanitarian projects across the world, offering several opportunities for the BRE Trust to work closely alongside these projects, providing technical support and knowledge dissemination activities, and where appropriate making use of the QSAND tool.

## QSAND

### Moving forward

As part of an ongoing review of the QSAND programme, the BRE Trust is developing a strategy for supporting the humanitarian and development sectors globally. In addition to expanding the scope of QSAND, the aim is to develop a network of partners to form consortia for supporting development action. The development of the QSAND network was reinforced by the QSAND stakeholder workshop, which took place on the 4<sup>th</sup> September and brought together practitioners and academics with a prior knowledge or involvement in QSAND to discuss the future of the BRE Trust humanitarian programme. Many of the suggestions and relationships developed at the workshop have fed into the forward plan for QSAND.

The Trust is also looking to move away from focusing solely on post-disaster reconstruction, to a more rounded resilient construction programme offering benefits in various low-income situations. The aim is to use elements of QSAND that support sustainability and resilience to create training materials and programmes. These will inform the construction, reconstruction and maintenance of communities that are vulnerable to disaster, before any such event occurs.

Transitioning away from purely post-disaster activity presents a new opportunity for QSAND:

- 75% of the global population will live in towns and cities by 2050 – with 3 billion people in informal settlements.
- 95% of urban growth will be in developing countries.
- For every \$1 spent on building resilience and preparing for disaster, \$4 are saved in recovery.
- Small cities (less than 500,000 people), which have the largest portion of the urban population in developing countries, are usually less prepared for extreme events and less likely to receive international help.
- 80% of houses rebuilt after disasters are built by the inhabitants with little to no input from builders, engineers, or architects.



In situations where inhabitants are building their own homes, often with no professional support, the impact of QSAND could be significant, with relevant QSAND themes being used to develop training courses for inhabitants and housebuilders – delivered by local and international NGO networks. In addition to developing training materials, partner organisations are being identified through which training can be administered to a wider audience. We are engaging with student societies at institutions including Engineers without Borders (see below), and an increasing number of UK universities to potentially support the creation of QSAND-based educational materials. We are also extending links with international universities in areas where we could support humanitarian action, for example through links with the Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC) at the Chinese University of Hong Kong. A few examples of the relationships we are looking to build on in order to develop a network of implementing partners are outlined below.

**Catholic Relief Services**, which applied QSAND in Nepal and the Philippines and was a partner in developing the humanitarian demonstration shelter, remains the Trust's main partner in the humanitarian sector. A new QSAND application project focused on the resettlement of displaced peoples in Myanmar is in development. Subject to final approval at CRS, this will be the first application project where QSAND is used in response to a conflict situation rather than a natural disaster, which will help to support the widening of the tool's scope.

In addition to PhD studentships at **Loughborough University**, the Trust is supporting Dr Long Seng To in her RAEng fellowship project "Enhancing Community Energy Resilience Using Renewable Energy in Developing Countries".

Through this she will help to develop the energy component of QSAND, and further technical guidance on energy resilience for the humanitarian and development sectors. The Trust is looking to expand the partnership with Long Seng and other researchers at Loughborough, to include projects related to community resilience in China, and to develop a streamlined guide to energy resilience and sustainability for the humanitarian sector.

The Trust has made links with the **Engineers Without Borders** (EWB) student society at Loughborough University. EWB members have visited BRE Watford to learn about QSAND and other Trust work in the humanitarian sector, and the Trust is presenting an introduction to QSAND to the new students at the start of the academic year. We are also developing a partnership with EWB UK to produce training materials for academic courses that are focused on sustainability in humanitarian and development contexts, and are looking to develop links with other EWB student chapters.

**RedR UK** – we are seeking partner organisations through which QSAND training can be administered to a wider audience. RedR UK has been involved with the development of QSAND and is one of the largest training providers to the humanitarian sector. Following further discussions with RedR and other training providers, and in consultation with some of our university partners, we will be looking to develop education materials based on the key concepts of QSAND.

Continuing to develop the partnerships outlined above and earlier in this report – and establishing further relationships with practitioners, academics, private sector organisations and donors – are key to expanding the BRE Trust's reach and impact.



Engineers Without Borders Student Society from Loughborough University on their visit to BRE earlier this year.

## QSAND stakeholder workshop

A QSAND stakeholder workshop was held on 4th September 2019 to review the BRE Trust's engagement opportunities with the humanitarian and development sectors (see also page 12). The aim was to engage with stakeholders working in the sector – and/or with those with previous experience of using and developing the QSAND tool – to assess the potential for QSAND development and increase the impact of BRE's educational and training outreach.

Joining the Trust Secretariat and BRE experts at the meeting were representatives from academia and industry, and from a range of humanitarian organisations such as Catholic Relief services, CARE International and Save the Children.

The objectives were to gather knowledge to support the Trust's aims in disaster risk reduction, resilience and sustainability, and identify humanitarian and international development issues where the Trust could make a difference. It also aimed to identify the QSAND tool's current strengths and weaknesses, and to form and reinforce partnerships to enable the delivery of QSAND-related materials in the field.

### Overall session outcomes

Key to increasing the impact of both QSAND and BRE Trust wider programmes will be:

- creating and developing partnerships with practitioners and academics at both the local and international level,
- producing material that is ready for dissemination – i.e. accessible, targeted towards an appropriate audience and in-line with existing guidance and documentation already available,
- updating QSAND materials to clarify its aims and uses, as well as to highlight **why** it is important,
- focusing on the communication of programmes and working with partners to ensure that we are complementing existing activities and not duplicating efforts,
- finding partners for delivery, and working with them on the development of materials that pair BRE's expertise with that of the sector and the local knowledge of communities,



- working with different stakeholders towards different but complementary goals, including international NGOs, academic institutions, development actors, local government, community organisations and donor institutions, to achieve multiple entries into the sphere.

### Next Steps

The session made clear the need to update the 'package' by which QSAND is delivered, and highlighted several avenues through which the BRE Trust can collaborate more effectively with its partners in this sector.

To take this forward, the Trust will continue to liaise with stakeholders on their projects and offer support wherever possible. This could include providing technical guidance and other materials, facilitating partnerships with other stakeholders, working on joint funding proposals for research projects, and developing a key network of delivery partners for QSAND and other BRE projects.

The Trust will also develop the 'QSAND brand' to increase accessibility, by creating new training and education materials in collaboration with partners and focused around a particular audience, updating the website and other promotional materials to make the tool easier to understand, and providing complementary technical guidance for practitioners in the field.



# The Construction Knowledge Task Group

**BIM has transformed access to data and information, but “construction industry knowledge remains resolutely unreformed,” says Gregor Harvie of Designing Buildings Wiki.**

The adoption of BIM by the construction industry has transformed data and information from a fragmented, incompatible, and often incoherent stream of characters into a standardised resource that can be manipulated and exploited.

In stark contrast, construction industry knowledge remains resolutely unreformed. There is no standardisation, no integration and only limited digitisation. This makes it difficult to find, access and apply knowledge, and as a result research and innovations are not adopted, best practice is not followed, compliance is patchy, and lessons are not learned.

The Construction Knowledge Task Group (CKTG) was created in 2018 following an industry workshop convened by Designing Buildings Wiki at which more than 20 organisations expressed an interest in making construction knowledge smarter.

A CKTG survey revealed that a third of practitioners do not feel they have easy access to the knowledge they need to do their job. Practitioners also confess to using Google searches and free websites in preference to in-house knowledge or subscription services because they are faster and easier – even though they trust them less.

In response to this, CKTG members agreed to work together to make it as easy as possible for practitioners to find, access and use the knowledge they need, when they need it. The initial focus of this work is to create a standard classification system. The adoption of such a system would unlock industry knowledge, turning it into a consistent, machine-readable resource that is ready to be exploited. This would allow it to be embedded in BIM models, integrated with business systems, interrogated by search tools and curated for practitioners based on their individual needs.

This move to smarter construction knowledge will help the industry change faster and perform more consistently, contributing to the transformation the industry is being challenged to deliver.

You can find out more at:  
[www.designingbuildings.co.uk/CKTG](http://www.designingbuildings.co.uk/CKTG)



# Completed Projects

Retrofit Training Modules - £40k Trust, £20k in-kind contribution  
Interpreting SDGs for application at infrastructure - £15k Trust project  
Measuring Dementia - £30 Trust, £75k cash contribution

## Retrofit Training Modules

**Poor quality design and installation of energy efficiency measures when refurbishing homes, can prevent the expected energy and cost savings from being achieved, and increase moisture, air quality and other problems. A series of training videos to raise awareness of key technical refurbishment topics – aimed at surveyors, designers and others involved in domestic refurbishment projects – is now freely available.**

With around 15% of carbon emissions being accounted for by 25 million UK homes, domestic energy efficiency measures can help to meet climate change targets – and reduce fuel poverty, improve thermal comfort and increase security of supply.

The government has set a target of improving the Energy Performance Certificate (EPC) rating of all homes to Band C by 2035. Policy initiatives to this end include the Energy Company Obligation (ECO), which has led to the installation of insulation and heating systems in 1.8 million low-income and vulnerable households.

There has been concern, however, that the standards of design and installation of these energy saving features has often been inadequate, so they may not deliver the expected savings and could increase moisture problems, fire risks and poor air quality.

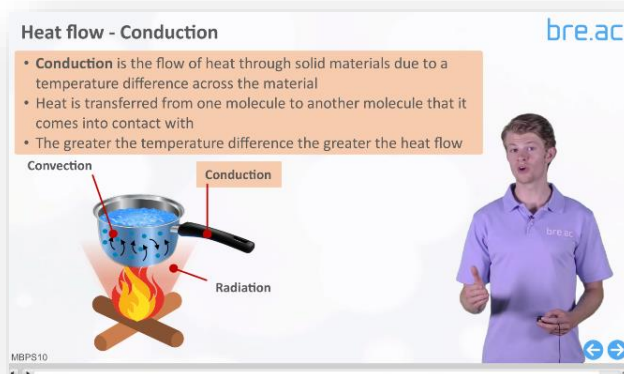
This was a driver behind the Each Home Counts (EHC) Review, which recommends a quality mark and

supporting technical codes of practice and standards to cover the design and installation of energy efficiency measures. Key to this is the upskilling and training of those delivering these measures.

A new BRE Domestic Retrofit Training Course consisting of six 20-30 minute modules is now freely available. It has been designed to raise awareness of a number of technical refurbishment topics – moisture awareness, airtightness, exposure, external wall insulation, building physics and unintended consequences. The course is aimed at the two key roles of surveyor and designer, but is also relevant to others involved in domestic refurbishment projects – clients, materials providers, installers, site managers and assessors.

The course is consistent with the EHC review recommendations and the proposed technical direction of PAS 2035 *Code of practice for the energy retrofit of buildings* (and associated standards), which is now being developed. As well as introducing the key technical issues involved, it provides a first step to further training to become accredited under PAS 2035, which will enable practitioners to display the EHC Quality Mark.

With funding from the BRE Trust, the course material has been prepared by BRE experts and the training modules made available by the BRE Academy at [www.bre.ac](http://www.bre.ac). Users of the modules are invited to provide feedback on the content and the method of delivery so that these can be improved and developed further.



## Interpreting SDGs for application at infrastructure project level

In 2015 all of the world's governments committed their countries to achieving the United Nation's Sustainable Development Goals (SDGs) by 2030. The SDGs are focused on monitoring, evaluation and accountability across society at project as well as nation level. However, they and their associated targets have not been written with infrastructure projects in mind. So whilst infrastructure development has the ability to make the biggest impact, it is not immediately obvious how to apply, measure and monitor the SDG targets at a project level.

### The project

This research aimed to provide knowledge of which SDG targets apply to infrastructure projects, raise awareness across the industry, and enable BRE to understand how CEEQUAL and other products might need to evolve.

The project identified SDG targets relevant to infrastructure and mapped them onto CEEQUAL and the Global Reporting Index (GRI). It investigated which of the 169 targets defined under the 17 SDGs apply to infrastructure projects, and how they can be efficiently measured and monitored.

### Findings

The project found that there is a good alignment between CEEQUAL and the SDGs, however terminology is sometimes different and so some form of interpretation is needed. The analysis also identified opportunities to further align CEEQUAL to the SDGs in future versions. This will result in CEEQUAL being more relevant in developing countries.

With regard to GRI, it has a lower correlation to the SDGs than CEEQUAL. The key difference is that whilst there are thousands of companies reporting against the GRI framework each year, very few have their reports independently verified. This is a key requirement for CEEQUAL certification and may provide opportunity for the two organisations to work together.

Clear, simple guidance is needed to help infrastructure project teams to interpret the SDGs for their projects, and identify which ones are significant and should be focussed on. While this project hasn't sought to deliver this, there is ongoing work in this area in the Institution of Civil Engineers (ICE) which BRE is feeding into – as both CEEQUAL and BREEAM have roles to play in raising SDG awareness.

### Impact

A paper detailing this work and its findings has been accepted by the peer reviewed ICE journal *Engineering Sustainability* (for publication online in December 2019 and in print in March 2020), promoting greater awareness of the topic and placing BRE at the forefront of the SDG discussion. The research is also feeding into the ICE's Sustainability programme which is developing awareness tools for engineers, and also defining methods of measuring impact.

This research has provided new knowledge on how BREEAM family of schemes can help to raise awareness of, and achieve delivery of, the SDGs in the built environment. The detailed analysis from this research is being taken forward by the BREEAM Team to continue more detailed research and develop business cases for enhancing BRE schemes, and to produce a BRE branded briefing paper on BRE's role in assisting industry in achieving the SDGs.





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## Measuring Dementia

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**This project has developed a method of assessing the effectiveness of measures taken to create supportive environments for those with dementia.**

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

As part of the development of dementia-friendly demonstration house ('Chris and Sally's House') on BRE's Innovation Park, 12 parameters common in most housing were identified as having both negative and positive effects on someone living at home with dementia. There has been, however, a lack of knowledge concerning the influence of such parameters on building performance, and a lack of a means of assessing the effectiveness of measures taken to create supportive environments for those with dementia.

### The project

This project has developed a means of creating consistency around how buildings should be adapted for dementia, and a methodology for assessing the impact of dementia adaption measures.

The parameters for dementia design were tested with stakeholder groups, and a first version of a home adaption guide methodology and scoring mechanism was developed. These were then finalised after being 'road-tested' in two pilot projects.

### Impact

This project could see a shift in how home adaptation for an ageing population (and dementia) is perceived, specified and delivered. The methodology and scoring system will give consistency and credibility to the adaptation of buildings and will be applicable to all properties. In addition, they may influence changes in associated standards and regulations. The project could also lead to greater adaptation capacity being embedded in new-build housing to reflect the changing demographic and the new models of care being proposed.

### Next steps

The project team have identified six opportunities to deploy the methodology in 'real' development projects. The next steps will involve progressing these opportunities and raising the profile of BRE's growing expertise in this area.



As part of the development of the demonstration house, launched in July 2018, 12 key factors affecting people living with dementia were identified. These have been used to develop an adaption assessment method.

## University Partners

## University of Bath

Professor Pete Walker, Director of the BRE Centre for Innovative Construction Materials, reports that the group remains active and involved in a wide range of work, including:

- On-going work on various research projects including:
  1. EPSRC project 'RM4L – Resilient materials for life'.
  2. EPSRC equipment grant 'VSimulators: Building Occupant Interaction Simulator'.
  3. EPSRC project 'Assessment, Costing and enhancement of long life, Long Linear assEtS'.
  4. EPSRC project 'Autonomous Aerial Robotic Manufacturing'.
- Richard Ball and colleagues successfully organised the 39th Cement and Concrete Science Conference in Bath (10-11 September 2019).
- Pete Walker submitted ERC Advanced Fellowship application.
- Kevin Briggs submitted RAEng (5 year) Senior Research Fellowship application.
- Tim Ibell started Programme Grant with Cambridge (UK FIRES). The part of the programme in Bath aims to provide a performance chart for embodied carbon in concrete buildings.

**Projects completed this quarter:**

- Sustainable Bio and Waste Resources for Construction. Interreg project.
- Enhanced earth-based building materials network for low income housing targeted to Sri Lanka. Academy of Medical Sciences. Juliana Holley.
- Laminated Bamboo testing. Xylotek. Bhavna Sharma.
- GCRF Safer communities with natural hazard resilient housing. EPSRC. Pete Walker.
- Harvest to Construction (H2C): Community based bamboo production of engineered bamboo. Bhavna Sharma.

**Loughborough University**

**A PhD studentship study of the potential of distributed ledger technologies to improve traceability assurance in the construction industry.**

**Alistair Wilson**

There is growing interest in being able to track and trace construction products – and the information about them – through global and complex supply chains. Alistair Wilson is Investigating the potential of distributed ledger technologies (DLT) to improve traceability assurance in the construction industry.

The study initially aims to explore the concept and theoretical underpinnings of traceability. It will then investigate current practices in traceability practice, both cross-sector and within the construction industry, and identify the drivers and emerging trends in traceability in construction. Alastair will then go on to assess the potential utility of DLT for product traceability, identify the requirements, challenges and enablers for using DLT to improve traceability assurance, and develop and validate a framework for traceability assurance in the construction industry.

In the first year he has completed the study of the theory of traceability and started to access the potential for DLT through the production of a literature review. A preliminary model of the information lifecycle of a construction product has been developed.



## Social Innovations systems for buildings resilient communities

Donagh Horgan

This project is producing guidelines and recommendations to support the development and use of social innovation systems and community engagement in the building of resilient communities. It is mapping new knowledge on social innovation systems for building resilient communities by identifying and analysing the supporting networks (practitioners, policy-makers and stakeholders), frameworks (policies, strategies and systems) and architectures (services, strategies and solutions). The methodology includes case studies of live or completed social innovation and community engagement projects.

During this year Donagh has been on an Erasmus placement at the University of Belgrade, researching a case study of Yugoslav housing systems. She investigated research into housing in new Belgrade and conducted a number of face-to-face interviews with relevant academic (and other) stakeholders in the city.

While in Belgrade Donagh also planned her last case study – looking at urban development in the post-industrial city of Lille, Northern France. This will conclude the investigation aspects of her research and from late Autumn 2019 she will begin the final write-up, collation and edit of her doctoral thesis.

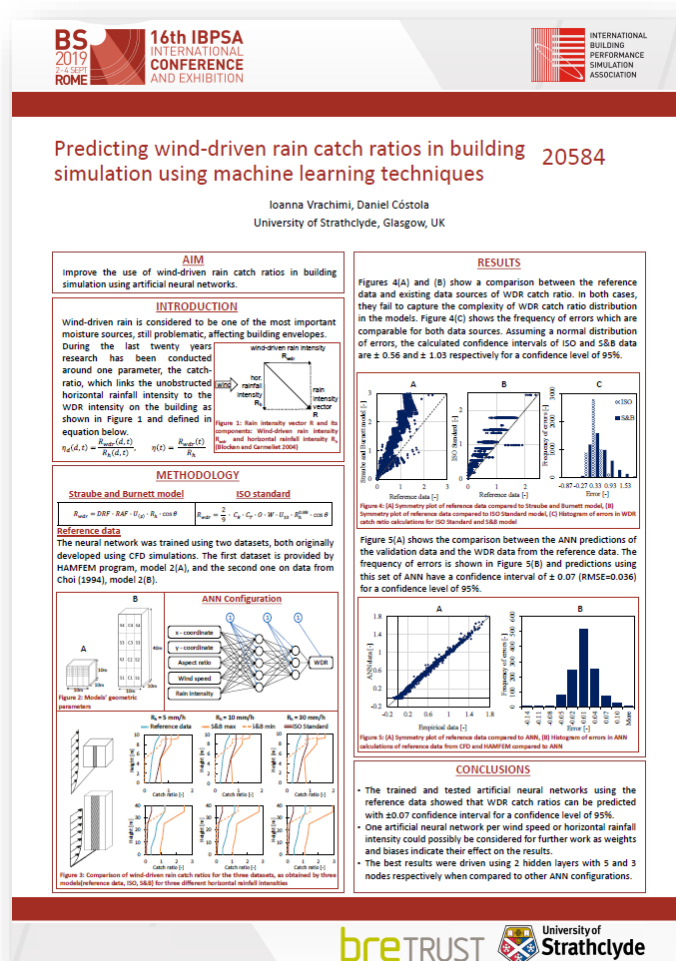
## Characterising building stock for energy labelling

Ioanna Vrachimi

Decisions makers that manage energy use in building stocks need high quality data to help them to identify poor performing buildings or areas, and strategies to improve energy efficiency and reduce consumption. This project aims to improve techniques for energy modelling of city building stocks in order to enhance the mapping of energy use. While energy modelling can be valuable in identifying a way forward, it is subject to uncertainties due (in part) to the simplifications and assumptions made – including those relating to physical phenomena such as wind pressure, wind driven rain on a building façade, sky temperature and many more. These are typically addressed by using a coefficient, which is usually calculated with linear regressions, as the computational power and information needed to model at that deep level are not available.

This project is applying machine learning – the use of mathematical techniques to extract patterns from data – to overcome the problem of oversimplified physical conditions, thus providing a less costly means of accurately extrapolating data from samples to develop building simulations.

This method has been used so far to tackle three physical phenomena, including wind driven rain – one of the most important moisture sources affecting building envelopes. Ioanna Vrachimi is researching this area and recently contributed an associated presentation and poster at BS2019, the IBPSA International Conference and Exhibition in September 2019, on *Predicting wind driven rain catch ratios in building simulation using machine learning techniques*.





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## University of Edinburgh

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Professor Grunde Jomaas, BRE Chair of Fire Safety Engineering, reports that, “The group remains very active and is involved in a wide range of activities. Group members attended summer schools, conferences and workshops, for most of which presentations, posters and papers were given.

“Various group members remain active in committee and standardisation work related to Grenfell Tower, cladding materials, British Standards updates (e.g. BS 8414 and BS 9414), and MHCLG. We have also offered a CPD course related to fire safety of timber.”

### Smart Urban Resilience and Firefighting

In recognition of the threat that densely populated city areas pose in terms of managing major emergencies, a research project called “SureFire: Smart Urban Resilience and Firefighting” has been funded by Hong Kong Research Grants Council (RGC). A sum equivalent to £3.5 Million has been awarded to an international team for a five-year project due to start in January, 2020. The University of Edinburgh is part of this team, with Dr Stephen Welch as the co-I.

For details see [www.bse.polyu.edu.hk/research/FireEng/SureFire.html](http://www.bse.polyu.edu.hk/research/FireEng/SureFire.html)

### Foreign guest researcher

Dr Xu Dai took up a one-year appointment as Foreign Guest Researcher at National Institute of Standards and Technology to work on the project, *Steel-Concrete Composite Floor Systems Subject to Fire – Phase 2*, in October 2019. While there Xu will continue to be involved in the RFCS-funded TRAFIR project.

### Award

Antonela Colic, an IMFSE student currently in Edinburgh, won the best poster award at the 3<sup>rd</sup> International Symposium on Fire Safety of Facades in Paris in September 2019. Her poster was entitled, *Influence of window openings on fire development in ventilated facades*.

This quarter Dr Angus Law, BRE Lecturer in Fire Safety Engineering, presented his work on test methods at the IFE conference in Melbourne, Australia. His research projects on timber and rammed earth were also presented at conferences in London. There have been two journal publications on Dr Law’s recent work on competency and cladding. The seminar he previously gave on the principles of competence to the CIC’s IRG has now been formalised in the ‘raising the bar’ report.

Dr Law is supervising two BRE Trust supported PhD students, Vasileios Koutsomarkos and Arjan Dexters.

**Vasileios Koutsomarkos’** project is on *Developing a Fire Resilience Assessment Methodology for the Built Environment*. The first phase of an intensive literature review was finalised in this quarter, focussing on past reviews of various methodologies. The main findings have been drafted for submission to a scientific journal.

**Arjan Dexters’** project is on *Testing for knowledge: maximising information obtained from fire tests by using machine learning techniques*. In this quarter Arjan investigated, and recreated in MatLab, three contemporary screening models for the SBI test: i) The one-dimensional flame spread model by T. Hakkarainen (2001). ii) The model by P. Van Hees (2002) also known as ConeTools II; iii) The update to ConeTools II by A. S. Hansen (2002). The new machine learning model can either be compared with the non-learning models in terms of performance, or they can be incorporated into the new model to provide a solution for the lack of learning data.



THE UNIVERSITY  
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# Programme Dissemination

## Sales and Downloads

### BRE Bookshop

**Retail sales**, including those through Amazon and Taylor and Francis International, totalled 507 units for the quarter July to September 2019. This included 146 sales through IHS Retail.

Bestsellers in this quarter include: BR 209 *Site layout planning* which sold 25 copies, DG 365 *Soakaway design* sold 22 copies, BR 211 *Radon: Guidance on protective measures* (2016 ed) sold 16 copies, and titles describing non-traditional housing types (AP149 and AP294) attracted 9 sales.

**Subscription sales** – the BRE Connect Hard Copy service has been wound up due to lack of material. All customers have been migrated to BRE Connect Online where they have online access to some 1800 BRE publications. At end of September 2019, there were 274 BRE Connect Online subscribers.

### Construction Information Service (CIS)

Analysis of the Top 20 CIS downloads reveal that CIS users value:

- BRE guidance on ground engineering and related subjects with 6 titles in the Top 20 downloads
- the Expert Collections for their convenient format with 5 collections in the Top 20, 2 of which are fire-related.
- reference books on core subjects, eg the building elements: foundations, walls and roofs are all in the Top 20
- guidance on radon-related subjects with 2 titles in the Top 20.

CIS downloads during July-September 2019 totalled 27,770.

## Designing Buildings Wiki

### General performance

By the end of this quarter there were 8639 articles on Designing Buildings Wiki, and the site was visited by 1,915,840 unique users.

Designing Buildings Wiki received 4,674,150 page views, a 30% increase compared to the same quarter in the previous year. The BRE Trust logo appears on every page of the site and so was viewed 4,674,150 times.

### BRE articles

By the end of the quarter, there were 421 BRE articles on Designing Buildings Wiki. These can be seen at:

[www.designingbuildings.co.uk/wiki/BRE\\_articles\\_on\\_Designing\\_Buildings\\_Wiki](http://www.designingbuildings.co.uk/wiki/BRE_articles_on_Designing_Buildings_Wiki)

[www.designingbuildings.co.uk/wiki/BRE\\_Buzz\\_articles\\_on\\_Designing\\_Buildings\\_Wiki](http://www.designingbuildings.co.uk/wiki/BRE_Buzz_articles_on_Designing_Buildings_Wiki)

This content was viewed 32,784 times during the quarter.

The top 5 BRE articles were:

- BREEAM (2,201 views)
- BRE Digest 365 Soakaway design (1,384 views)
- Fire performance of external thermal insulation for walls of multi-storey buildings (1,117 views)
- Tiled floors with underfloor heating: A guide to minimising and repairing cracking (1,035 views)
- Electricity supply (834 views)

### BREEAM Wiki

There are now 268 articles on BREEAM Wiki.

These can be seen at:

<https://www.designingbuildings.co.uk/wiki/Category:BREEAM>.

This content was viewed 24,021 times during the quarter (there may be some overlap between these and page views of BRE articles).

## Other Events and publications

### Building of the future

On 1 October 2019 the BRE Trust, with support from BRE staff, hosted the five winners of the University College of Estate Management (UCEM) 'Building of the Future' competition for a day of activities at BRE's Watford site.

The five school children aged between 12 and 16 from schools across the south east of England, had each designed an innovative sustainable building to address future built environment problems. These included an eco-school which encouraged learning about the natural environment through its inclusive wildlife design, and an underwater family home built from sustainable materials and enabling high levels of self-sufficiency.

During their visit the children were given insights into the many ways BRE tackles sustainability, hearing from research experts about their current projects and being taken on laboratory tours by BRE technicians. Highlights included a tour of the Xylarium by Gerald Moore, during which the children were shown the complexity of identifying individual species, and their incredible variation.



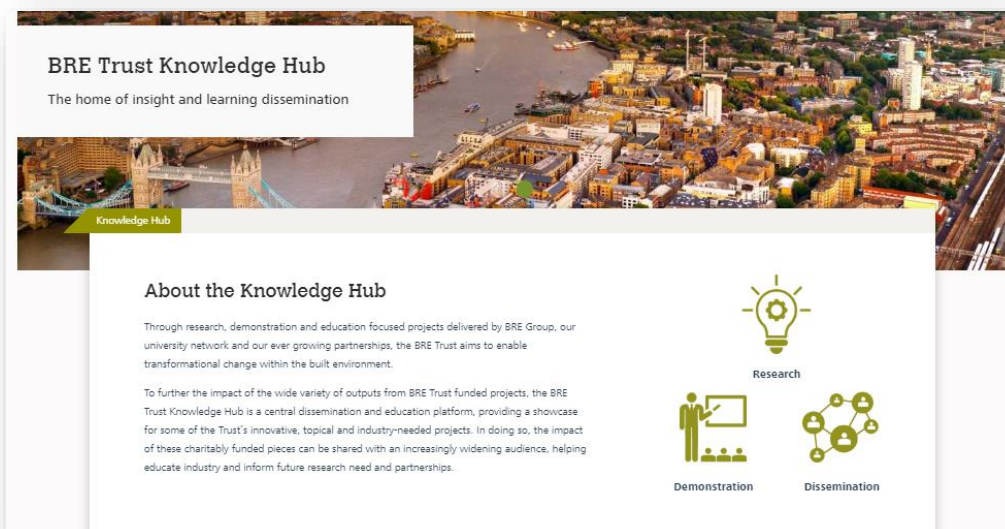
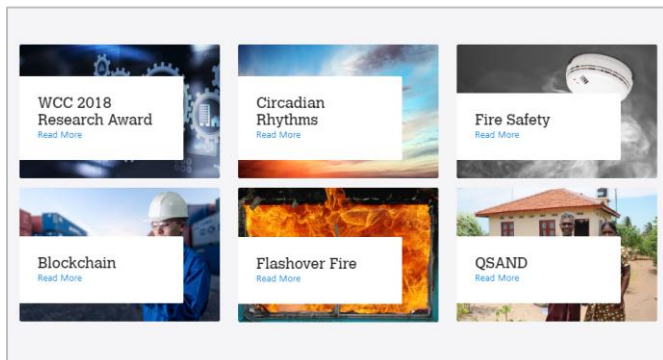
*"Amelie attended the 'Building of the future' day today and she hasn't stopped talking about it! Thank you so much for giving her this opportunity, for inspiring her and for sparking her interest in innovation and sustainability. I'm sure this will stay with her forever and may well guide her career path in future."*

**Amelie's Mum**

### BRE Trust Knowledge Hub

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.

Currently presenting a selection of case studies, the plan is for the Knowledge Hub to expand to include multi-media updates on live Trust projects, to encourage conversation and partnerships.





## Using BIM to improve operational waste management in buildings

**Research exploring the potential of applying BIM to improving operational waste management in buildings – in a project supported by the WCC Research Award 2018 – is presented in a new video.**

While the use of building information modelling (BIM) in building design and construction phases is well established, the use of BIM in the operation and management of buildings is still at a very early stage. With huge volumes of waste being generated in the UK and landfill space increasingly scarce, Dr Ricardo Codinhoto of Bath University – a BIM specialist – developed a project to investigate the use of a BIM-based model in operational waste management. Dr Codinhoto was the winner of the BRE Trust sponsored Worshipful Company of Constructors (WCC) Research Award 2018, for this project.

The Trust has subsequently funded the production of a video in which Dr Codinhoto describes the conduct and outcomes of this research. Bath University – with its 118 buildings, 20,000 occupants and annual waste generation of 280 tonnes – was used by the project team to represent a mini-city, in which the flows of people, waste and waste services, and the geometry of the buildings, could be modelled.



Dr Ricardo Codinhoto, winner of the BRE Trust sponsored WCC Research Award 2018, explaining his project to apply BIM to operational building waste management.

The aims of this work included finding ways of improving the efficiency of waste collection, and of identifying waste generation ‘hotspots’ where interventions could most effectively be made to reduce waste.

Among the project’s conclusions were that a digital system could support the reduction of waste generation, and the Internet of Things could be used to increase the accuracy of waste management systems. However, the current waste information available is not generally sufficient to produce effective operational waste management models. If waste information collection was expanded, meaningful interventions are possible that could improve collection efficiency and reduce waste generation.

The video can be seen on YouTube at [www.youtube.com/watch?v=kze6PEBxrCg&feature=youtu.be](http://www.youtube.com/watch?v=kze6PEBxrCg&feature=youtu.be)



# Appendix A: 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** - £72.5k. **Status** – In Progress

### Demonstration & Dissemination

- Measuring dementia home adaptation. **Trust Contribution** - £30k. **Other Contribution** - £75k. **Status** – Complete

## Property

### Research

- Centre for Smart Homes. **Trust Contribution** - £53.6k. **Other Contribution** - £81k. **Status** – In Progress
- 3 Resilience - Tackling overheating in urban dwellings. **Trust Contribution** - £40k. **Status** – Stalled
- Optimum replacement of detectors. **Trust Contribution** - £30k. **Other Contribution** - £37.5k. **Status** – In Progress
- Redevco real estate asset performance. **Trust Contribution** – 80k. **Status** – In Progress
- Redevco QSAND bringing sustainability to post disaster relief. **Trust Contribution** – 100k. **Status** – In Progress
- Interpretation of SDGs for application at Infrastructure project level. **Trust Contribution** - £15k. **Status** - Complete

### Demonstration & Dissemination

- 100 Years of Council Housing. **Trust Contribution** - £8.9k. **Other Contribution** - £8.25k. **Status** – In Progress
- Adapting with Age. **Trust Contribution** - £2.5k. **Status** – Complete
- UK Housing in 2017. **Trust Contribution** - £8k. **Other Contribution** - £11k. **Status** – In Progress

### Skills & Learning

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

## Places

### Demonstration & Dissemination

- Contribution to the “Guide to creating Positive spaces using pre and Post Occupancy Evaluation”. **Trust Contribution** - £7.7k. **Other Contribution** - £15k. **Status** – In Progress

## Appendix B: Current Studentships

<b>People</b> (Health, productivity, safety and wellbeing)
<b>Places</b> (community resilience, climate affects)
Social innovation systems for building resilient communities, <i>Donagh Horgan, University of Strathclyde</i>
Development strategies for future cities to ensure energy resilience, <i>Ciaran Higgins (Part-time), University of Strathclyde</i>
<b>Property</b> (efficiently and sustainably, resource efficiency, further proof, house quality)
Low cost approach for characterization of Residential Building stock for energy labelling, <i>Ioanna Vrachimi, University of Strathclyde</i>
Whole-Timber Structural Systems, <i>Aurimas Bukauskas, University of Bath</i>
Next generation natural fibre reinforced geopolymers, <i>James Bradford, University of Bath</i>
Optimising phase change material use for energy- efficient buildings, <i>Ahmad Wadee, University of Bath</i>
Developing a Fire Resilience Assessment Methodology for the Built Environment, <i>Vasileios Koutsomarkos, University of Edinburgh</i>
Testing for knowledge: maximizing information obtained from fire test, using machine learning techniques, <i>Arjan Dexters, University of Edinburgh</i>
Self-healing concrete, <i>Lorena Skevi, University of Bath</i>
Building energy and environment: measurement, data, analysis and interpretation, <i>Daniel Franks, Loughborough University</i>



BRE Group  
Bucknalls Lane,  
Watford,  
WD25 9XX

T **+44 (0)333 321 8811**  
E **[enquiries@bre.co.uk](mailto:enquiries@bre.co.uk)**  
W **[www.bre.co.uk](http://www.bre.co.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  
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