BRE Trust Quarterly Review

January - March 2019

Prepared by the BRE Trust Secretariat

Summary of this report

This report presents highlights from the research, education and dissemination activities supported by the BRE Trust during January to March 2019. It also includes the first in a series of reviews of key work areas, starting with the flood resilient repair element of our Resilience Programme.

Flood Resilient Repair – The BRE Trust Built Environment Resilience Thematic Programme ran from 2015-2017, with follow on work thereafter. The programme's flood resilient homes project was developed to increase flood resilient repair uptake by homeowners, supported by standards and contractors able to deliver cost-effective measures

Research project reports:

The full cost of poor housing in Wales. New analysis of poor housing in Wales supports the case for investing in home improvement rather than paying, through the NHS and other agencies, for the reduced wellbeing and prosperity that poor housing can cause.

Developing test methods for video fire detectors. BRE Trust supported research by BRE, in collaboration with video fire detector manufacturers, has developed benchmark and operational performance test methods for video flame detectors and video smoke detectors.

Wood in healthy buildings. A new TRADA Briefing document, *The role of wood in healthy buildings,* written by BRE with BRE Trust support, investigates and discusses the potential roles for timber in supporting health and wellbeing.

Research Award

The BRE Trust sponsored, Royal Charter International Research Award for Young Constructors, was presented to Dr Alastair Marsh at the Worshipful Company of Constructors' Livery & Awards Dinner. He received the award for his project on using waste rice husk ash in sustainable, low-cost cement-stabilised earth blocks, in partnership with a Ugandan charity.

Event Report

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

Publications:

QSAND case studies, launched at the above event, describing disaster relief operations in Nepal and the Philippines, where QSAND was used to help integrate sustainability and resilience in reconstruction.

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

Regular dissemination and partnership reports:

Sales and downloads – updates from the BRE Bookshop and Construction Information Service (CIS).

BRE Academy – the latest on new international BIM standards, fire training qualifications, international developments and university engagement.

Constructing Excellence – reports on the annual Parliamentary Reception, implementing a new structure, supporting a platform approach to construction and the performance measurement forum.

Partnership programmes – reports on Article 25's programme of Make Design Matter talks, and quarterly reports from the University of Edinburgh Centre for Fires Safety Engineering and the University of Bath Centre for Innovative Construction Materials.

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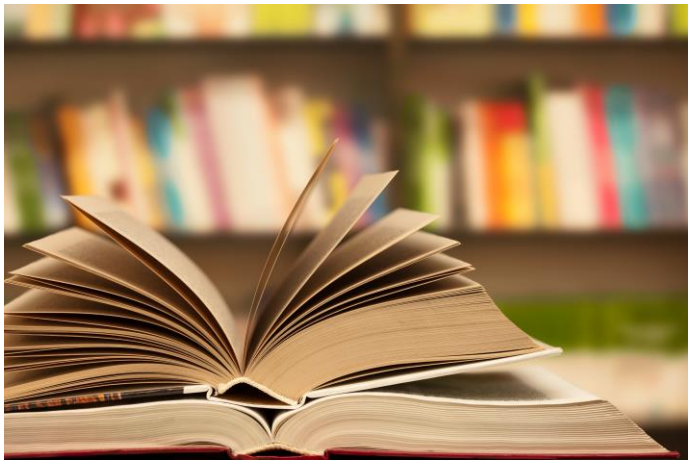


Resilience programme – flood resilient repair

The first in a series of reviews on key areas of BRE Trust support.

A combination of climate change, urbanisation and population growth is presenting huge challenges to the way we develop the built environment. With increasing frequency, destructive floods, storms and heatwaves are claiming the lives of people around the world and causing widespread building damage.

Research and training programmes supported by the BRE Trust have been tackling the risks from flooding, windstorms and overheating to buildings, as well as addressing disaster reduction.

Flooding has long been recognised as the UK's greatest natural threat, with Environment Agency data showing around six million UK homes to be at risk from rivers and sea, surface water and groundwater flooding. This review highlights the flood resilient repair element of the Resilience Programme, and ongoing work in this area.

Flood resilient repair

In December 2014 the BRE Trust approved plans for the Built Environment Resilience Thematic Programme - starting in April 2015. The programme's flood resilient homes project was developed to increase relevent repair uptake by homeowners, supported by standards and contractors able to deliver cost-effective measures. Homes repaired in a resilient manner will be less damaged by further floods and so have much quicker recovery times and lower costs. The project's objectives were to:

- establish the state of the art in flood resilient repair for existing homes,
- develop performance measures that can form the basis of a flood resilient repair standard for existing homes, and then develop the standard by creating technical guidance,
- demonstrate flood resilience measures using the Innovation Park at Garston.

Flood resilience

The term *flood resilience* combines resistance to flooding with recoverability should flooding occur.

Resistance involves keeping floodwater out of a building. *Recoverability* refers to measures taken to enable homes or businesses to quickly recover if flood water does enter.

A timely reminder

If the importance of this work needed any further emphasis, this was provided by the extreme weather conditions in the UK during the winter of 2015/16. Storms Desmond and Eva caused flooding in the north west of England that resulted in damage to thousands of properties, at a cost estimated by the Environment Agency to be around £1.6 billion.

This prompted the UK Government to set up of a Roundtable of private and public sector members to deliver the Property Flood Resilience Action Plan of recommendations and actions to make the UK more flood resilient. BRE's CEO at the time, Peter Bonfield, was asked to Chair this initiative by Rory Stewart MP (then Environment and Rural Affairs minister). The Trust's Resilience Programme and the flood repair project, as well as BRE's nearly two decades of relevant research, were important factors in Defra's request for BRE to be involved in the roundtable.

Dovetailing smoothly with the Trust's own initiative, and driving close cooperation between the two programmes, the flood resilience issues considered by the Roundtable included standards, skills and training – and alongside these, the need to demonstrate what good practice actually looks like.

Showing what good practice looks like

With its considerable experience of demonstration buildings on the Innovation Parks, and a Victorian terrace house available for refurbishment, BRE's Watford site was highly suitable as the location of a flood resilient demonstration home.

The resulting Flood Resilient Repair House has done much to meet the aims of both the Roundtable and the BRE Trust Programme, creating a fully functioning showcase of flood resilience good practice, with the potential to feed into the development of training, standards and certification. It has also strongly engaged with industry (see right for list of partners), attracting more than £30,000 in cash from industry partners, and over £30,000 of in-kind contributions.

Avoiding a cycle of damage repair

The repair of flood damaged homes has generally involved striping soggy plasterboard, removing flooring and ripping out saturated chipboard kitchen materials – and then, once the house has dried out, putting the same sort of materials back in to suffer the same fate in the event of future flooding.

The Flood Resilient Repair House uses alternative replacement products in repairs, which will reduce the damage caused by subsequent flooding. These include various types of 'closed-cell' insulation in the walls and under the floor, kitchen units and doors made from resin-bonded board, and waterproof magnesium oxide wall boards instead of plasterboard.

The Home also shows how simple measures, such as placing electrical outlets higher up walls and using doors and windows with flood resisting seals, can help minimise future damage. And, if water does get in, an automatic sump pump connected to drains in the floor quickly removes water from the house (see boxed test on page 6 for more on these measures).

The house is resistant to flood water up to 600mm (2 feet) deep and, should the water enter the building, dries out quickly, enabling the occupants to return home a very short time after flooding.

Influencing change

The Flood Resilient Repair House has proved to be an important demonstrator for influencing change in the way many in industry and government are thinking about dealing with flooding and its aftermath – and has been widely reported in the media.

On BBC 1's Countryfile programme, for example, the house was put to a stern public test. Several thousand litres of water were poured into the house by the local fire service. While only creating a shallow 'flood', this would have caused severe damage to most homes, and taken days or weeks to properly dry out.

Although the house is designed to be flood resilient, it still looks and feels homely.

Sponsors and supporters of the Flood Resilient Repair House:

BRE Trust
Axa Insurance UK
Cunningham Lindsey
Property Care Association
Natural Cement Distribution
British Damage Management Association
BACA Architects
UK Government department responsible for flood risk
The Environment Agency
Aquobex
UK Flood Barriers
Aviva
Association of British Insurers
HBOS Lloyds
BRUFMA
Kingspan
Celotex
Isothane
BASF
Concrete Block Association
Delta Membranes
Proten
Tarmac Bellitex
Miinus Pustelli
Dragon Board

BRE's Flood Resilient Repair House being put to the test for the BBC's *Countryfile*.

Here, just hours after filming was completed, the water had all been removed via the floor drains and sump pump, and the house was dry and warm.

Practical demonstration in Cumbria

The Cumbria Flood Resilience Showcase Project is implementing the type of resilience measures featured in the demonstration house in two properties – a community centre and a converted barn – both of which were seriously damaged during Storm Desmond (2015).

BRE's digital tool, the Property Flood Resilience database, is being used to record and understand measures already implemented, and measures that can be included to increase resilience, in three sections:

- Resistance – *involving all possible entry points (e.g. doors and windows).*
- Resilience – *recovery aids such as wall and floor finishings.*
- Community – *Barriers, SUDS (Sustainable urban drainage) and local flood wardens.*

The tool enables two scores to be produced, one giving a current, overall resilience score for the property, and one that shows what it could be once suggested measures have been implemented. The tool is intended for use by surveyors or any professional evaluating the properties.

Resistance and recoverability measures used in the house include:

Water resistant insulation in the walls and under the floor.

Kitchen units and doors made from resin-bonded board and fitted with all-ceramic worktops.

Waterproof magnesium oxide wall boards instead of plasterboard.

Ceramic tiled floor and loose rugs in place of fitted carpets.

Keeping vulnerable items out of the way of any future flood water:

Sockets and switches placed higher up the wall, with wiring to them from the ceiling.

Kitchen appliances mounted at worktop height.

Lower kitchen cupboards fitted with slide-out baskets that can be placed on the worktop.

Preventing flooding seeping in under the floor from rising groundwater:

Membranes installed under the floor and in the walls to divert water towards …

drain channels beneath the floor around the perimeter of the room, directing water into …

a sump in the corner of the home fitted with automatic pumps to remove the water.

Stemming the flow of flooding reaching above door sill level:

Enhanced seals and locks to the doors and windows to make them floodproof.

Air brick covers.

One-way valves in the main drains to prevent water coming up into the home via the sewers.

Drains fitted flush with the floor, connected directly to the sump and pump.

Developing standards and technical guidance

A report on the Trust project's first objective – establishing the state of the art in flood resilient repair – was produced at an early stage in the project and provided the basis from which to prepare standards and technical guidance.

There have been some existing standards for the resistance element of flood resilience, as this is easier to quantify – for example, the British Standards Institute (BSI) has created test

standards, and there are PAS standards for aperture products such as doorways, windows and airbricks.

But there haven't been any standards for the recoverability aspect of resilience, because of the extensive range of elements that it encompasses. BRE has been working on a recoverability standard that is now going through internal reviews. Further to this, a methodology for scoring resilience has also been developed by BRE, alongside industry partners. This is based on many of the findings from the Flood Resilient Repair House, and from working with other stakeholders in this sector.

Producing a code of practice

In the course of the research to develop a standard, a group of professional institutions (ICE, CIWEM and RICS) formed a committee to develop a code of practice for making homes and buildings flood resilient. As a result, BRE is now working with the University of West of England, Whitehouse Construction and the Environment Agency, on a project funded by AVIVA, the EA, Scottish Government, Welsh Government and Northern Ireland Government, and managed by CIRIA, to produce the code of practice.

The code covers the whole process and the skills required for each of its stages – from conducting a property hazard assessment, surveying the building and designing suitable measures, to having those measures installed, commissioning and handing over to the occupant/client, and then ongoing operation and maintenance. Elements of this sort of guidance has been available in the past, but never as a whole consistent and coherent process.

The code includes standards that define exactly what should be done with the key requirements, and a guidance section that has processes for each stage – following these ensures the standards' requirements are met.

It comprises a primary document and two supplementary documents. The primary document is aimed mainly at the professionals involved, such as surveyors, contractors, hazard assessors, consultant, etc. The supplementary documents are aimed at the general public, particularly home owners, and local authorities and planners. They are due to be issued for public consultation shortly, with publication of the final versions due around December 2019.

Training and certification

Following the Flood House project, BRE and the BRE Academy have developed a series of flood resilience training resources, both on-line and classroom based. They include a range of short courses and webinars, along with a detailed 12-hour Property Flood Resilience Surveyors' course. After completing the surveyors' training course and meeting certain requirements, participants also have the option of going on to be certificated under a BRE Global certification scheme.

The resilience surveyors' training programme and certification scheme, along with a series of six flood resilience webinars, were launched at the BRE hosted Flood Resilience Summit at the Innovation Park in February 2018.

Further areas and opportunities

Sustainable drainage

While it is highly desirable to keep flood water out of a building, in an urban environment this can potentially divert water to where it will be a problem elsewhere. As well as flood resilience in individual buildings therefore, BRE is looking at aspects of community resilience. The use of sustainable drainage systems (SUDS), for example, is being investigated with BRE Innovation Park partners, who are trialling the use of permeable paving at various points around the site.

Opportunities in high demand areas

BRE has been working for the Greater London Authority on elements of flood resilience planning. The GLA has tied flood risk, green infrastructure – e.g. SUDS and green and blue roofs – and water use together as part of the London Plan.

While not able to make these measures compulsory (there isn't yet sufficient research evidence to enforce them through the building regulations), in urban areas like London – and other UK cities – where there is high building demand, initiatives such as the London Plan can take the opportunity to raise building quality by pressing for buildings plans that, for example, include flood defence measures.

Wider use

When it comes to taking these flood resilience approaches to areas of large-scale flooding abroad, there are challenges with the different building

practices and standards, etc. But there has been some interest from countries – such as Malaysia – where flooding from tropical storms, severe monsoons, etc are a relatively common occurrence.

Getting the message out

There is still an urgent need to raise awareness of the availability and effectiveness of flood resilience measures. The code of practice will help with this, but BRE has an important role to play through its demonstration house, training courses, events and other initiatives.

One of the key messages to be promoted is that while developers often think incorporating flood resilience measures mean considerable extra costs, there are ways of improving resilience – a number of which have been demonstrated in the BRE house – that involve little or no added cost.

More information

Property Flood Resilience Action Plan:
www.bregroup.com/expertise/resilience/flood-resilience/property-flood-resilience-action-plan/

BRE Innovation Parks:
https://www.bregroup.com/ipark/

Flood Resilient Repair House:
https://www.bregroup.com/expertise/resilience/flood-resilience/bre-flood-resilient-repair-house/

Cumbria Flood Resilience Showcase:
http://www.floodguidance.co.uk/cumbria-flood-resilience-showcase/

Flood resilience training:
https://www.bre.ac/search-results?_sf_s=flood

London Plan:
https://www.london.gov.uk/what-we-do/planning/london-plan

University partners support of the flood resilience programme

Our university partners have made important contributions to the flood resilience programme, for example through a number of BRE Trust supported PhD projects including:

Flood resilience: Improving building drying times
Bath University.
This study is identifying experimental and analytical methods of exploring moisture absorption, migration and desorption during a cycle of flooding and drying, in order to developing a better understand of the behaviour of masonry wall structures.

Community Resilience to Natural Hazards
Loughborough University.
Madii Edgeworth: Understanding Community Resilience to Natural Hazards in South Asia
to inform and influence stakeholders and specifically improve assessment tools.

Resilient and sustainable urban infrastructures
Cardiff University.
This project encompasses a holistic approach to built environment resilience in the face of natural hazards, targeting both the urban and building-scale level of analysis from quantitative and qualitative perspectives. It is delivering a decision and policy-making model for resilient and sustainable urban infrastructures.

Research reports

The full cost of poor housing in Wales – £7.5k Trust, £7.5k cash contribution.

Video fire detectors – £5k Trust.

Timber in healthy buildings – £5.2K Trust, £2k cash contribution, £3k contributions in kind.

The full cost of poor housing in Wales

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

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

What is poor housing?

Poor housing has been defined, for the purposes of this research, as a home that doesn't meet the current minimum Welsh housing standards because it has one (or more) Category 1 Housing Health and Safety Rating System (HHSRS) hazard.

The HHSRS identifies defects in homes and evaluates their potential effect on the health and safety of occupants, visitors, neighbours and passers-by. A Category 1 hazard is a serious and immediate risk to health and safety (less serious hazards are Category 2).

There are 29 HHSRS hazards in four groups:

physiological – e.g. damp, cold, asbestos, carbon monoxide,

psychological – e.g. space, lighting, noise,

infection – e.g. pests, refuse, sanitation, drainage,

accident – e.g. falls, electrical hazards, fire.

In this home access to the rear garden and garage is via steep steps that are in disrepair, slippery, slope dangerously and have a loose handrail. As the rain water drainage discharges directly onto the steps they are always wet and following a very cold night would be icy.

Wales has the highest proportion of poor housing among the UK nations, largely due to its older housing stock, and the UK has the oldest housing stock of all EU member states. The older a dwelling is, the more likely it is to represent a health and safety risk. A home built before the First World War, for example, is seven times as likely to have a significant health and safety hazard than one built after 1980.

A model developed for this study, using statistical extrapolations from the BRE 'cost of poor housing' research, estimated that the UK had the highest health costs related to poor housing in the EU – lagging far behind countries such as Denmark which has a very high-quality housing stock.

Methodology update

While there has long been a recognised relationship between poor housing and poor health, the methodology developed by the BRE Trust, which underpinned the 2008 *Cost of Poor Housing in Wales* report, is perhaps the most rigorous attempt

to measure the cost to the National Health Service (NHS) and society.

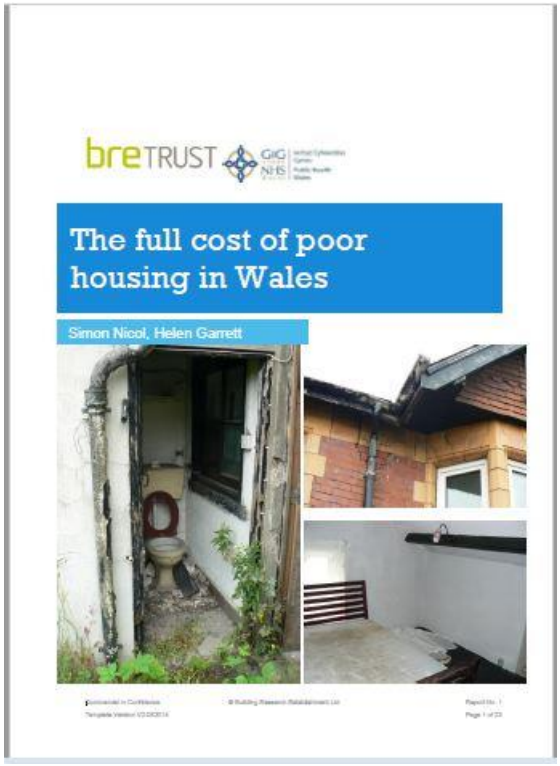
In 2016, BRE published an updated methodology, reflecting new knowledge and information, and incorporating the re-calculation of health benefits associated with energy efficiency improvements, and updated (2011) NHS treatment costs. The recent research into the 2017 costs of poor housing in Wales uses the updated methodology, and the most recent 2017 Welsh Housing Conditions Survey data.

Key findings

The recently published report, *The full cost of poor housing in Wales* by Simon Nicol and Helen Garrett includes the following key findings listed in the report are:

- In 2017, the total number of homes with at least one Category 1 hazard in Wales was an estimated 238,000, some 18% of the total housing stock.
- The most common Category 1 hazards relate to falls in the home and the consequences of living in cold housing.
- The cost of reducing the hazards in these poor homes to an acceptable level is estimated to average £2,455 per home – a total cost of £584 million for the whole stock.
- If remedial works were undertaken 'up front' to mitigate these Category 1 hazards, there would be an estimated benefit to the NHS of some £95 million per year.
- Remedial works to mitigate Category 1 hazards would pay for themselves in reduced NHS costs within 6 years. The costs of improving cold homes are some of the most expensive, but also the most effective in reducing costs to the NHS.
- These costs represent first year treatment costs to the NHS alone, following a housing related accident or diagnosis. The annual cost to the NHS represents around 10% of the full economic cost to society of leaving people living in unhealthy housing in Wales, which is estimated at £1bn per year.

The full report is freely available from: www.bregroup.com/bretrust/learning-and-skills/publications/



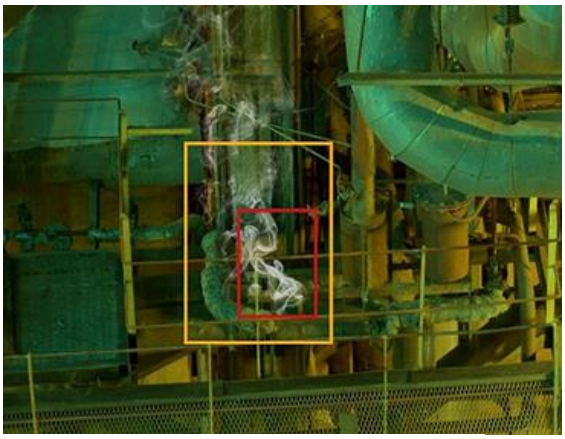
Developing test methods to assess video flame and video smoke detectors

Video fire detectors emerged as a new means of fire detection around 15 years ago, particularly in large indoor spaces such as those in atria, warehouses and industrial complexes. Detection of fires in such spaces has traditionally been provided by optical beam smoke and aspirating smoke detectors, or flame detectors – but video fire detectors potentially offer important advantages.

They can 'see' the fire

A video detector is alerted to the presence of a fire by identifying the characteristic signatures of smoke or flame within the field of view of its camera. The images from the live video feed are analysed by sophisticated algorithms to detect these signatures. There are two detector types – video flame detectors (VFDs) that recognise flaming fires, and video smoke detectors (VSDs) that are alerted to the presence of moving smoke. Some systems can have both sets of algorithms working independently at the same time.

The detector does not need to be in proximity to smoke or flames to detect fire as (provided there is direct line of sight) it can 'see' them. This enables a quicker response than is generally achievable by traditionally used smoke and flame detectors, and can also provide a visual verification of fire.



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

Analysing the response of video fire detectors to a smouldering cotton fire in the BRE Fire Test Room.

No current means of testing/assessing capabilities

While there has been a significant amount of fundamental research work on the capabilities and potential applications of video fire detectors, due to their complexity there are no defined and robust methods of assessing the capabilities of these detectors for testing and certification purposes.

Work by BRE Global and the Fire Industry Association (FIA) to develop test methodologies for these technologies has identified the greatest obstacle to be a lack of benchmark tests of basic performance.

These are needed to perform the fundamental tests of repeatability, reproducibility and environmental testing defined in the EN 54 Fire detection and fire alarm systems standard. Additionally, operational performance tests are needed to verify the absolute capabilities of video detectors in detecting the fires anticipated in service environments.

Collaborative research programme

A BRE Trust supported research programme was established by BRE, in collaboration with video fire detector manufacturers, to develop benchmark and operational performance test methods for both video flame and video smoke detectors. To gain the necessary underpinning knowledge on the performance capabilities of video fire detectors, the research group has developed methods for bench testing and full-scale fire testing of these systems.

The group's development of methodologies for assessing the performance of VFDs and VSDs has been summarised in a briefing paper that will shortly receive final BRE approval. It is now expected that these methodologies will support the development of a Loss Prevention Standard and LPCB Code of Practice.

Wood in healthy buildings

Dr Ed Suttie, BRE's Strategic Advisory Director, launched a new TRADA (Timber Research and Development Association) Briefing document at the Timber Trade Journal's Wood and Wellness Conference on 13 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. It was prepared by Dr Suttie with funding support from the BRE Trust.

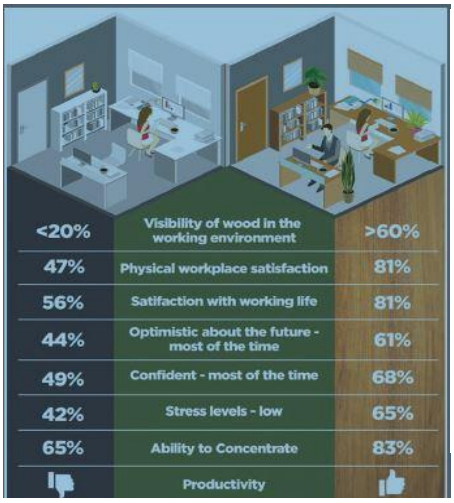
Wellness

With growing evidence that exposure to the natural world can enhance health and wellbeing, the issue of *wellness* is becoming a mega trend in the built environment, with building and interior design increasingly taking account of the health and wellbeing of occupants.

The *Wood and Wellness* conference was held to look at wood's role in this trend, and to consider the opportunities for trees and wood products to shape this new world of wellness.

The Briefing document 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.

'This is a flag in the ground,' said Ed Suttie at the conference, 'a starting point, coalescing the current evidence. It points towards how we as an industry can work together to fundamentally start to deliver health and well-being through the use of timber and timber products in buildings and construction'.



Benefits of wood in the workplace. Image: Forest and Wood Products Australia Ltd.

Examining the evidence

The new publication reviews the issues to consider when delivering healthy buildings, such as indoor air quality, damp and mould, design and ergonomics, and biophilia (which acknowledges our genetic connection to nature), and the role of timber in these factors. Timber is a highly versatile material found in structural components, insulation, linings, floor cassettes and finishes, furniture cladding and fit-out.

The Briefing document examines the evidence for the ability of timber and timber products to enhance healthy buildings, including the potential physiological and psychological benefits in education, healthcare and office buildings, illustrated with case studies from the UK and around the world.

Regarding the psychological benefits, for example, research has found that the visual presence of wood indoors can significantly reduce stress levels amongst occupants. Wood is associated with warmth, being a natural insulator as well as having warm colour tones.

Examples presented for potential physiological benefits include hygrothermal mass. Temperature and moisture are key aspects of interior spaces and research suggests they can be affected by the choice of surface materials. Wood absorbs moisture from the air when humidity levels rise and releases moisture back into the environment when it dries. Release of heat is associated with adsorption and heat is required during desorption. These processes give rise to the concept of hygrothermal mass, which may mediate temperature and moisture levels and has the potential to improve energy efficiency in buildings.

Building assessment

The document also reviews the extensive range of assessment schemes – and their direct and indirect impacts on healthy buildings – around the world. These include whole building assessment methodologies such as BREEAM, whole building health and wellbeing schemes such as Well and FitWel, and healthy materials certifications and schemes such as Ecolabels.

For more information and access to this report visit www.trada.co.uk/news/new-trada-briefing-document-the-role-of-wood-in-healthy-buildings-packs-a-punch/

Research Award

2019 Royal Charter International Research Award for Young Constructors

Sustainable, low-cost cement-stabilised earth blocks

Building blocks for more affordable and sustainable homes

The Royal Charter International Research Award for Young Constructors, which is co-funded by The BRE Trust, was presented to Dr Alastair Marsh in February 2019 at the Worshipful Company of Constructors' Livery & Awards Dinner at the Haberdashers' Hall in London.

A research scientist at the University of Leeds, Alastair won the award for funding to carry out research to investigate the use of rice husk ash as a supplementary cementitious material in the production of cheaper and more sustainable building block for homes in Uganda

Huge need for affordable, sustainable homes

The huge global need for affordable and sustainable housing can be particularly acute in developing nations where there is rapid population growth. In Uganda for example (the population of which is predicted to more than double by 2050), this has led to an increasing demand for fired-clay brick homes, which can offer a better quality of life than those using traditional materials. But they have a far higher financial and environmental cost – gathering firewood for fuelling brick kilns causes deforestation, and CO_2 is generated from the firing process.

A lower cost alternative

Cement-stabilised earth blocks (CSEB) are an alternative to fired bricks and have lower environmental and financial costs. They are made by mixing soil with a small amount of Portland cement to make them durable, and then compacted in a manual press and cured in atmospheric conditions.

Although Portland cement is the minor component of CSEB, it dominates the blocks' cost and environmental impacts. Finding a way of reducing the cement could further improve affordability and sustainability. With this in mind, the charity organisation HYT Uganda – which trains young Ugandans in the manufacture and use CSEB – approached Alastair Marsh for advice.

Alastair Marsh (third from left) was presented with the 2019 Royal Charter International Research Award for Young Constructors.

Using rice husk ash

Alastair was aware of recent laboratory studies showing the potential for using rice husk ash to partly replace cement in CSEB, and the need for field research to test these findings. Rice is an important cash and food crop in Uganda, where the husks are either discarded or burnt in incinerators to generate heat – producing ash waste.

Meeting the huge global housing demand requires affordable and sustainable building materials.
(Image courtesy of HYT Uganda)

Cement-stabilised earth blocks are compacted in a manual press and cured in atmospheric conditions.
(Image courtesy of HYT Uganda)

Cement-stabilised earth blocks have lower financial and environmental costs than fired clay bricks.
(Image courtesy of HYT Uganda)

Recognising an opportunity to both field-test rice husk ash and support HYT Uganda's work, Alastair submitted the winning proposal to the BRE Trust sponsored Award, which provides £8,000 towards project costs.

To develop a 'recipe' for using in CSEB, the project will complete the preparatory work this year and conduct the testing work – partly in Uganda with HTY Uganda and partly at Leeds University – in spring/summer 2020 to tie in with the rice harvest.

Use of rice husk ash in future cements?

As part of his work at the University of Leeds, Alastair is investigating new forms of cement. Alkali-activated cements (AACs), for example, are binder materials that may perform as well as Portland cement, but have lower environmental impacts. Fly ash and ground granulated blast furnace slag are among waste materials used as precursors for AACs, but in many countries are not readily available. However, rice husk ash can be used to produce a sodium silicate activating solution, which can be used to make AACs with other precursors such as clay-rich soils.

The investigation of rice husk ash use in earth building blocks in Uganda, will also give Alastair an opportunity to examine the potential for using this waste product in the manufacture of alternative cements in future.

A fuller report on this project is available on the BRE Trust website at: www.bregroup.com/bretrust/2019/04/30/building-blocks-for-more-sustainable-homes-uganda/

Event report

Working together for disaster relief.

Working together for disaster relief conference

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

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

After a morning session of scene setting presentations, such as on the field experiences of representatives from Nepal who responded to the 2015 earthquake, delegates participated in breakout sessions on key disaster response issues:

Research and development – the barriers to academic and private sector technical expertise being effectively applied in humanitarian response, and how to tackle these.

Supporting local enterprise and building capacity – improving collaboration with disaster-affected communities, and examining how international operators can best support localisation.

Construction and infrastructure in humanitarian action – how can private sector technical expertise best be used in disaster response?

Financial Services, Technology and Operations in Post-Disaster Reconstruction – how humanitarian agencies are embracing new technology and innovations in the financial and digital spheres to improve service provision.

These sessions formed the basis of a panel discussion on potential next steps in improving collaboration between relief agencies. These include:

Delegates receiving first-hand accounts of disaster relief activities in the field.

A follow-up local conference being organised by delegates from Nepal in collaboration with CRS to maintain links between the government and private sector organisations who supported the 2015 earthquake response.

A mailing list of delegates to stay in contact and continue the conversation. CRS is hoping to make this event the first in a series to provide updates on progress in localisation and knowledge sharing.

Consolidation by BRE Trust of its forward plan in the humanitarian sector. Several humanitarian sphere projects have been undertaken by different parts of BRE, which will form part of a more cohesive programme. This conference helped to map out gaps in the sector where the BRE Trust could potentially focus its efforts. It also strengthened BRE's relationship with CRS – a key partners in using QSAND and developing the demonstration shelter on the Innovation Park – and enabled BRE to showcase its current work and intentions in this sector to other potential partners.

QSAND case studies

Two case studies on the use of the QSAND disaster response tool – published with BRE Trust support – were launched at the conference (see page 16 for details).

Publications

QSAND case studies

Interior environment design – air quality, lighting, acoustics

QSAND case studies

The Working together for disaster relief conference (see page 15) saw the launch of BRE Trust supported case studies describing disaster relief operations in Nepal and the Philippines, where QSAND was used to help integrate sustainability and resilience in reconstruction.

QSAND (Quantifying Sustainability in the Aftermath of Natural Disasters) is a self-assessment tool to promote sustainable approaches to relief, recovery and reconstruction after a natural disaster. It was developed by the International Federation of the Red Cross and Red Crescent Societies (IFRC) in collaboration with BRE, and with support from the BRE Trust.

Anibong District, Tacloban, Philippines

The super typhoon that struck the Philippines in November 2013 was one of the strongest ever recorded, with over 1.1 million houses destroyed or damaged and over 12 million people affected.

In the coastal district of Anibong in Tacloban most of the houses and infrastructure were washed away. The relief organisation Catholic Relief Services (CRS), and its local partner Caritas Philippines, have been responding to the disaster since November 2013. CRS aimed to help 100,000 families using 'build back safer' techniques to increase community resilience and support livelihoods in the area.

In the early stages CRS used QSAND to support sustainability and resilience planning and implementation activities. QSAND was used to review and help identify any gaps in sustainability and resilience programming. This review took the form of a preliminary QSAND assessment during which all QSAND assessment and cross cutting issues were reviewed and considered.

QSAND case studies, produced with support from the BRE Trust, are available at: www.bregroup.com/bretrust/learning-and-skills/publications/

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

Gorkha District, Nepal

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

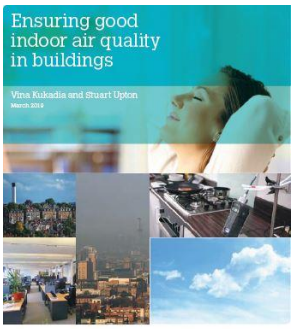
In Gorkha district the earthquakes were particularly devastating. CRS and its local implementing partners recognised the need for both quick emergency relief and a long-term plan to secure the livelihoods of the worst affected communities. They therefore chose to implement QSAND to help ensure that shelter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

Interior design guides

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

Indoor air quality

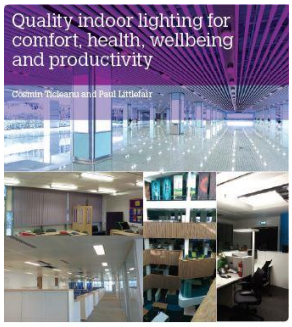
IAQ is complex with many factors affecting it, including a wide range of pollutants and sources, and building types, locations and decor. Exposure to different pollutants can cause varying health effects, from the worsening of asthmatic conditions and irritation of the skin, to premature deaths caused by heart and lung disease.

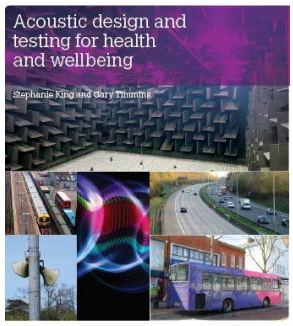


Buildings in urban areas are exposed to pollutants from outdoor sources, such as road traffic, boiler flues and other combustion plants, industrial processes and construction activities – so good ventilation is essential.

In the past ventilation has depended on air permeability through cracks and gaps in the building fabric, combined with air bricks, windows and mechanical ventilation. This does not necessarily improve indoor air quality and can result in excessive energy consumption. The modern approach is to 'build tight, ventilate right'. This means making buildings airtight and installing ventilation systems that reduce the ingress of outdoor pollutants, while preventing the build up of indoor pollutants.

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





Indoor lighting

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.

Acoustic design

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

It 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.

Regular dissemination and partnership reports

Sales and downloads

BRE Academy

Constructing Excellence

Partnership programmes – Article 25, Universities

Sales and downloads

BRE Bookshop

Retail sales, including those through Amazon and Taylor and Francis International, totalled 742 units for the quarter January to March 2019. This included 274 sales through IHS retail – a lower figure than usual due to low sales of *Good Building Guides* and *Good Repair Guides*. Particularly strong sales of these in the previous quarter had helped boost sales to 820.

Sales highlighted this quarter included nine DVDs on identifying non-traditional houses in the UK (AP 294), and 10 copies of *Recognising rot and insect damage in buildings* (BR 453) were sold through Amazon.

Subscription sales – The BRE Connect Hard Copy service has been wound up and all customers migrated to BRE Connect Online where they have access to some 1800 online applications. At the end of March 2019 there were 291 BRE Connect Online subscribers.

Publications due in 2019:
- *Thermal insulation: avoiding risks* (BR 262 4E)
- *Sustainability and fire risk in modern methods of construction (MMC)*
- *Emergency evacuation of high-rise buildings*
- *Walls windows and doors* (BR 352 2E).

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 six titles in the top 20 downloads
- the Expert Collections for their convenient format with four collections in the top 20.
- reference books on core subjects, eg the building elements: foundations, walls and roofs are all in the top 20 and floors at number 21,
- guidance on fire-related subjects with four titles in the top 20,
- reference on thermal insulation and dealing with damp with three related titles in the top 20.

Designing Buildings Wiki

General performance

By the end of this quarter there were 8007 articles on Designing Buildings Wiki, and the site was visited 2,185,447 unique users.

Designing Buildings Wiki received 5,620,235-page views, a 65% 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 5,620,235 times.

BRE articles

By the end of the quarter, there were 380 BRE articles on Designing Buildings Wiki. These can be seen at:
www.designingbuildings.co.uk/wiki/BRE_articles_on_Designing_Buildings_Wiki

www.designingbuildings.co.uk/wiki/BRE_Buzz_articles_on_Designing_Buildings_Wiki

This content was viewed 40,044 times during the quarter.

The top 5 BRE articles were:

- BREEAM (3,529 views).
- The daylight factor (1,376 views).
- Electricity supply (1,191 views).
- BRE Digest 365 Soakaway design (1,121 views).
- Fire performance of external thermal insulation for walls of multi-storey buildings 3E, BR 135 (983 views).

BREEAM Wiki

There are now 247 articles on BREEAM Wiki. These can be seen at:
https://www.designingbuildings.co.uk/wiki/Category:BREEAM.

This content was viewed 29,782 times during the quarter (there may be some overlap between these and page views of BRE articles).

BRE Academy

New International BIM Standard

The Academy is continuing to update its BIM training in light of the publication of the International BIM standard, ISO 19650. Last quarter we published our classroom BIM ISO Essentials course (see https://www.bre.ac/course/iso-19650-essentials-classroom/) and are working on the online equivalent. They are also developing the classroom and online versions for the follow-on ISO information management courses. The intention is to have all of the remaining courses ready for the Summer.

Fire training qualifications

The Academy already offers fire training courses on fire door inspection, fire stopping etc. As reported on previously, we are developing these into qualifications in response to the Hackitt review.

Specifically, our Fire Risk Assessment and Fire Door Inspection courses have been granted qualification status by ABBE (Level 4 Diploma and Level 3 respectively) and we are aiming to offer them both for the first time in July.

The have agreed with the AFSP to deliver their Foundation in Passive Fire Protection which is also a Level 4 qualification granted by IFE. We aim to start this in the Summer.

In addition, we have three other 1-day courses in the pipeline:

- Training looking at the issues surrounding poor installation of external cladding systems which includes an overview of BR135 and the relevant test standards it references (BS 8414 series) – this is close to sign-off with the first course to be delivered next month.
- Update of Timber door installation, maintenance and repair.
- Update of Fire stopping and compartmentation.

We will feedback on progress next quarter.

International

Last quarter developments in Russia and Brazil were highlighted. Over the last few months the Academy has continued to work with the BREEAM team on other international opportunities including Poland, Ukraine, Iceland, Latin America (Spanish speaking) and China. The focus has been BREEAM International New Construction, BREEAM AP, BREEAM Associate and BREEAM AG. Agreements are close to signature

Civil Engineering students from the University of Herts students undertake laboratory work and have lectures at BRE.

with a number of partners and those that develop will be reported upon.

University engagement

As noted in a previous Trust reports, BRE is partnering with the University of Herts (UoH) to help it deliver its Civil Engineering degree (BEng/MEng) and Oaklands college to deliver its BSc Construction Management. Students come to BRE to undertake laboratory preparation and testing of timber, steel and concrete as well as having lectures from BRE staff.

Last quarter saw BRE staff undertake testing of concrete beams with various levels of reinforcement for the Level 5 UoH students. In addition, staff have delivered lectures on BIM, offsite construction, site safety and lean construction as part of a construction management module.

Constructing Excellence

Annual Parliamentary Reception

BRE Trust Trustee and Co-chair of Constructing Excellence, Phil Wilbraham, welcomed more than 120 people to the Constructing Excellence Annual Parliamentary Reception at the House of Commons on 20 March. He gave a special welcome to the three newest national members, Tufeco, E.ON and Mott MacDonald, as well as the representatives from the newly launched Construction Innovation Hub.

Phil highlighted the four key areas of focus for Constructing Excellence in 2019 – Digital, Offsite Manufacturing, Procurement and Performance measurement – which will ensure the organisation is well placed to deliver its vision of 'positively disrupting industry delivery processes to transform performance.

Speakers at the event, which was hosted by Bradford South MP Judith Cummins, included Business and Industry Minister Richard Harrington, who highlighted the importance of construction to the UK economy and expressed his delight in securing the Construction Sector Deal.

New structure in 2019

The Construction Sector Deal highlighted by Richard Harrington at the Parliamentary Review, and the launch of the Construction Innovation Hub are aligning to provide conditions that will enable real change – according a Constructing Excellence blog on 21 March. The organisation has a real opportunity to be at the forefront of this change, but must focus on the activities and areas that are going to create genuine impact and align with its vision – the core elements of which are:

- a client-led transformation by procuring for outcomes and value,
- increased standardisation and pre-manufactured content,
- digitally enabled integrated teams working collaboratively with long-term relationships and aligned commercial arrangements.

To this end Constructing Excellence will be implementing a new structure with theme groups (and sub-groups) to drive progress across the core themes.

Phil Wilbraham speaking at the Annual Parliamentary Reception in March 2019.

Supporting a platform approach to building

In his 2017 Budget, the Chancellor of the Exchequer signaled the Government's commitment to using its buying power to drive construction sector modernisation by favouring offsite construction. To implement this, a new approach to building has been set out (to be adopted across government departments where it presents value for money), which is called a platform approach to design for manufacture and assembly.

A consultation to understand how prepared the sector is to adapt to a new approach to building closed in February 2019. Constructing Excellence fully supports the move to a platform approach to building, and particularly welcomes the launch of the Construction Innovation Hub and the work that it will do to underpin this approach.

In response to the Government's call for evidence, the Constructing Excellence Manufacturing & Technology Group held a workshop in January, and participants at the Constructing Excellence Annual Conference in December 2018 were also polled to gather their opinions on the platform approach.

Performance Measurement Forum

The Constructing Excellence Member's Forum on performance management, hosted by Burges Salmon, was held in February. A productive session gave Constructing Excellence a clear plan to reboot its work on performance measurement, KPIs and benchmarking – using its new Sitesmart KPIs portal – and to align with other industry initiatives.

There is more information on the above news items at: http://constructingexcellence.org.uk

Partnership programmes

Article 25's Make Design Matter monthly talks programme

The BRE Trust partners with Article 25 to provide support for its monthly talks programme, Make Design Matter. This promotes, publicises and disseminates the positive social, economic and environmental impacts humanitarian architecture and construction projects are having across the world.

Eight talks so far

To date, Article 25 has hosted eight talks. To raise the profile of humanitarian design and highlight the growing 'community of practice' with shared values around social impact-led architectural projects, the charity has sought the support of architects, engineers and others to host each talk. That way, it can showcase the work of that practice, build relationships amongst designers, engineers and the general public, and share valuable insight from each completed design & build project.

So far, there have been talks at: HKS (www.hksinc.com/), AKT II, (www.akt-uk.com/), SecondHome (www.secondhome.io), Hoare Lea (www.hoarelea.com/), The Building Centre (www.buildingcentre.co.uk/), Allies & Morrison (www.alliesandmorrison.com/), and Jestico & Whiles (www.jesticowhiles.com/).

The speakers have been:

Dan Flower, Design Director at HKS, on creating a passive designed maternity unit in Uganda,

Jateen Lad on the Centre for Rural Development in India,

Laura Katharina Straehle & Ellen Rouwendaal on pavilions for Okana, Kenya,

Kelly Doran at MASS Design Group on healthcare projects in Africa,

Matthew Cox and Max Kettenacker from Allies + Morrison on a Microloan Training Centre in Africa,

James Mitchell from Orkid Studios on social housing, healthcare and women in construction, Kenya.

Andrea Panizzo of EVA on public spaces in Haiti,

Bea Sennewald of Article 25 on the Bethel School in Gourcy, Burkina Faso.

Building a large, diverse audience

With bookings open for 'general sale' via Eventbrite, we know the audiences are an eclectic mix of architects, engineers, students, built environment professionals and the general public. Each talk has been attended by between 100 and 200 guests, and the total audience size reached face to face has been over 800 to date. 75% of the Facebook audience is aged 25-44, and 55% of the total audience are women. A video has been created for each talk and has been posted on our website and on YouTube to maximise digital dissemination.

In addition to the digital and social media promotion, Article 25 is also working with PR agency supporters at Farrer Kane to pitch a story into the built environment press. We are likely to use the first medical mission at the new Operation Smile clinic in Morocco (April 2019) and the first anniversary of the Pétionville School opening in Haiti (September 2019) as good hooks to attract press attention to the talks.

Thanks from David Murray

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

Report from the BRE Centre for Innovative Construction Materials, University of Bath

Centre Director, Peter Walker, reports on the group's wide-ranging activities during January to March 2019, including:

Research projects:

1. UKIERI project 'Developing Earth Based Building Products Utilising Solid Wastes'.
2. EPSRC project 'RM4L – Resilient materials for life'.
3. EPSRC equipment grant 'VSimulators: Building Occupant Interaction Simulator'.
4. EPSRC project 'Assessment, Costing and enhancement of long life, Long Linear assEtS'.
5. EPSRC project 'Autonomous Aerial Robotic Manufacturing'.
6. Interreg project 'Sustainable Bio and Waste Resources for Construction'.

UKIERI workshop co-organised with and held at the Indian Institute of Science, Bangalore, India (15 February 2019).

Industry engagement day held with local construction industry stakeholders through the ERDF Sustainable Hub fund on 31 January 2019 at University of Bath.

Twenty journal papers published by the centre's academic staff.

New funding has been secured:

- Circular Bio-based Construction Industry. Interreg Project. 450k awarded to Bath. Start summer 2019. Principal Investigator (PI) Bhavna Sharma.
- Automating Concrete Construction (ACORN). EPSRC. Started Jan 2019. 1.2M. Lead Paul Shepherd at Bath (Tim Ibell Co-Investigator (CI)).
- UK FIRES: Locating Resource Efficiency at the heart of Future Industrial Strategy in the UK. EPSRC programme grant. £5M. Led by Julian Allwood Cambridge. Tim Ibell CI (amount to Bath tbc). Starts 1 April 2019.
- Engineering Microbial-Induced Carbonate Precipitation via Meso-Scale Simulations. EPSRC. PI Bath Biology Dept. (Kevin Paine CI) 350k. Starts 1 May 2019.

Planned activities for the next review period include:

Richard Ball: two EPSRC proposals relating to indoor environment quality. Total requested approx. £2m.

GW4 workshops on Circular Economy for bio-based and waste materials in construction to be held at Exeter (7 May) and Bath (10 and 11 June).

VSimulator facility being installed in May-July 2019.

BRE Trust supported PhD student reports

Lorena Skevi – Bacteria-based self-healing concrete in cold climates

This project aims to develop smart, cement-based materials with self-healing and repairing capabilities. It is using bacteria that can microbiologically precipitate calcite in cracks.
During this quarter Lorena (pictured above) has made progress with an early-stage literature review, and started pre-tests with encapsulated bacteria (non-cryophilic) to investigate the potential of capsules for inserting the bacteria into concrete. She then started a series of tests on the effects of the bacteria on the strength properties of the concrete, which are about to be completed.

Fiona Gleed – Flood resilience: improving building drying times

Post-flooding reviews have highlighted the need to improve resilience, with drying of buildings identified as a key factor (see flood resilience feature on page 4). This is a study to identify experimental and analytical methods of exploring moisture absorption, migration and desorption during a cycle of flooding and drying, in order to developing a better understand of the behaviour of masonry wall structures.

The experimental work has been completed and Fiona is now writing up her thesis with the intention of submitting it in July 2019. She is also

developing an associated paper for the 39th Cement and Concrete Science conference (Bath, September).

James Bradford – Geocomposites: next generation natural fibre reinforced geopolymers

Conventional fibre reinforced polymer composites widely used in construction use resins and fibres based on fossil fuels. This project is investigating the use of natural alternatives to produce composites with very low embodied carbon.

In addition to formatting and completing the confirmation report resubmission, this quarter has included the continued successful use of a makeshift solvent trap yielding consistent and reliable rheology data – and analysis of that data, initial pH progression testing and analysis, and attempts at compression sample testing.

Aurimas Bukauskas – Inventory Constrained Structural Design

Forests worldwide face disproportionate demand for a small range of sawn-timber tree species, ages and growth shapes leading to low-diversity, overstocked forests. Unsawn 'whole timber' is a high-value alternative to sawn timber and can use a much greater range of tree types.

This project is developing design tools and digital fabrication methods to address the challenges of whole-timber building design, with phases one focussing on lightweight timber structures and phase two on low-coast social housing.

During this quarter the review paper, *Whole Timber Construction: A State-of-the-Art Review*, was published, and received positive feedback and interest from the timber engineering community. Aurimas also prepared and submitted a paper on the analytical methods for inventory constrained structural design to the journal *Computers and Structures*.

With the help of funding from the Worshipful Company of Engineers' Sir Peter Gadsden, Britain-Australia Travel Award 2017, Aurimas has been able to spend time at Queensland university with access to specialist capabilities. During this quarter he prepared to travel to and settle at the University's Timber Hub, where he is now working collaboratively with Dr Joe Gattas on the inventory-constrained structural design of lightweight timber structures.

Edinburgh BRE Trust Lecturer report

Dr Angus Law is the BRE Lecturer in Fire Safety Engineering at the BRE Centre for Fire Safety Engineering at the University of Edinburgh.

Last quarter overview

In the last quarter of the 2018 fiscal year, Dr Law has been finalising various papers to summarise the output from the work over the last year, and developing the next phase of experimental work on the Fire Spread from Mass Timber Buildings project.

Dr Law has continued his collaboration with the University of Queensland through engagement with a series of large-scale experiments that started in March. One of Dr Law's team travelled to Australia to assist with the setup of these experiments.

Abstracts for conference papers were accepted to Interflam, IFireSS, Fire and Explosion Hazards, and Dr Law has engaged in a correspondence in the letters pages of the IStructE magazine.

He has fully revised the teaching materials for the University of Edinburgh's 1st year Civil Engineering class, and completed the delivery of this class.

Planned activities for next review period

Dr Law's students will present work on fire spread from timber buildings at the Fire and Explosion conference in St Petersburg and Interflam. In addition, journal papers will be prepared that draw together the various conference outputs from the previous quarter. The second phase of work associated with the BRE Resilience project, will continue and will include interviews with key individuals involved with previous fire risk indices.

Studentships update

Vasilis Koutsomarkos is working on a project to develop a fire robustness index for assessing a building's ability to withstand a fire event. He commenced his next phase of this work and has undertaken a successful interview with Dr Paul Stollard concerning previous Fire Risk Indexing methodologies.

Dr Law will work with BRE to develop preferred project ideas into a full EPSRC proposal.

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
- Life-long health effects of poor indoor air quality. **Trust Contribution** - £15k. **Other Contribution** - £140k. **Status** – Completed
- The cost of poor housing in Wales, 2018, **Trust Contribution** - £7.5k. **Status** – Completed

Demonstration & Dissemination

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

Property

Research

- Suppression of Biomass Fires. **Trust Contribution** - £5k. **Other Contribution** - £35k. **Status** – In Progress
- Centre for Smart Homes. **Trust Contribution** - £53.6k. **Other Contribution** - £81k. **Status** – Completed
- Circadian lighting effects on health and wellbeing & Solar shading. **Trust Contribution** - £35k. **Other Contribution** - £45k. **Status** – Completed
- Resilience - Tackling overheating in urban dwellings. **Trust Contribution** - £40k. **Status** – Completed
- 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** – Completed
- 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
- 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

Demonstration & Dissemination

- The development of performance tests to assess video fire detectors. **Trust Contribution** - £5k. **Status** – Completed

Skills & Learning

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

Appendix B: Current Studentships

Social innovation systems for building resilient communities, *Donagh Horgan, University of Strathclyde*
Development strategies for future cities to ensure energy resilience, *Ciaran Higgins (Part-time), University of Strathclyde*
Low cost approach for characterization of Residential Building stock for energy labelling, *Ioanna Vrachimi, University of Strathclyde*
Automatic generation of BIM models by semantisation of building data, an application in the energy retrofitting domain, *Matthew Courtney, Cardiff University*
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*
Developing a Fire Resilience Assessment Methodology for the Built Environment, *Vasileios Koutsomarkos, University of Edinburgh*
Testing for knowledge: maximizing information obtained from fire test, using machine learning techniques, *Arjan Dexters, University of Edinburgh*
Self-healing concrete, *Lorena Skevi, University of Bath*
Building energy and environment: measurement, data, analysis and interpretation, *Daniel Franks, Loughborough University*

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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'.