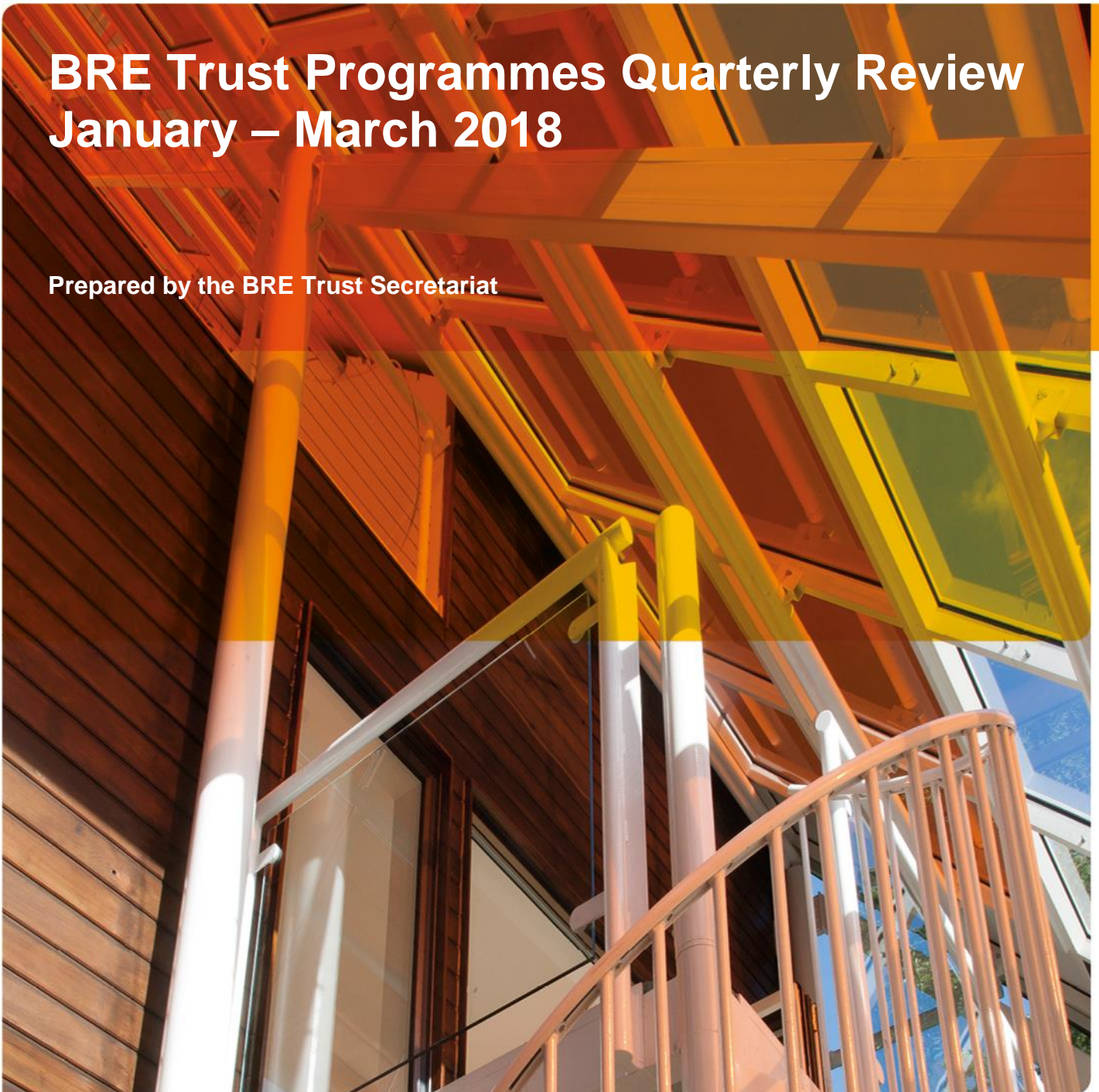


BRE Trust Programmes Quarterly Review January – March 2018

Prepared by the BRE Trust Secretariat



Executive Summary

This report summarises the progress of the BRE Trust Programmes during January – March 2018, including the research, dissemination, skills and university projects.

Also included are related activities including wider promotion of the Trust outputs via articles, publications, presentations and events. The outreach of these various platforms in sharing content are tracked and quarterly stats also included.

This report also includes a review of the annual out turn of the Trust Programmes. In summary, there are currently 11 live projects in the Programme with £370k of Trust funding now committed, also attracting over £900k cash and £1m in-kind funding from other sponsors and partners. There was 1 new project started in this quarter and 2 completed.

There are currently 22 active PhD studentships and 1 student successfully completed her viva (Rosalie Callway, Reading).

This report also includes a summary on Infrastructure and the collaboration and future of BREEAM Infrastructure and CEEQUAL.

New projects approved include:

Disseminating knowledge through digital training £40k Trust funding, £20k from partners; Using the BRE Academy's ability to reach thousands of professionals this project will create material content to form a training programme that addresses identified industry needs associated with retrofit. As well as engaging with BRE's technical experts there will be interaction with our partnered universities to ensure that this project is looking to the future needs of the industry.

Further information on this and other projects which are progressing or have been completed can be found within this report. These include:

People

The Life-long health effects of poor indoor air quality; **£15k from BRE Trust, £140k other contributions**

Property

BIM Case Studies; **£24k from BRE Trust, £22k other contributions**

Blockchain Feasibility; **£15k BRE Trust, £15k other contributions.**

Connectivity for Smart Homes; **£53k BRE Trust, £63.5k other contributions.**

Places

QSAND and Redevco Foundation Collaboration **£20k Trust £100k other funds**

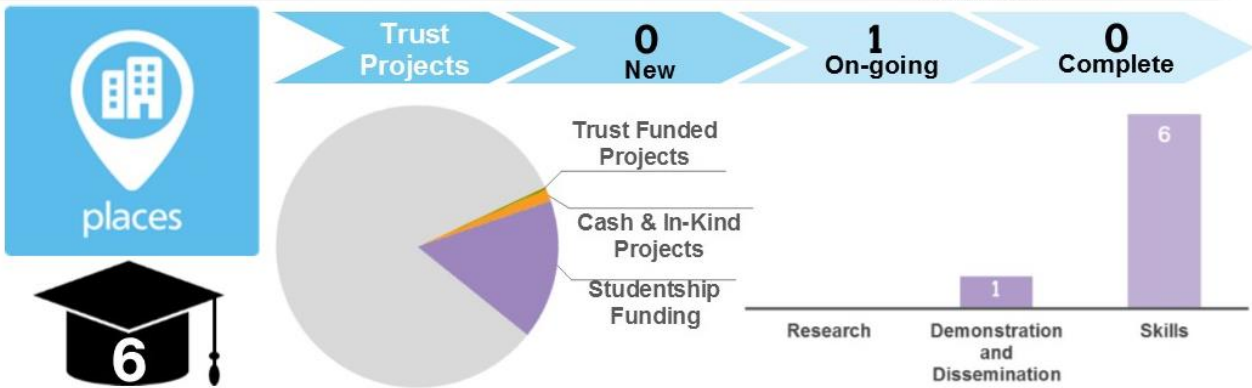
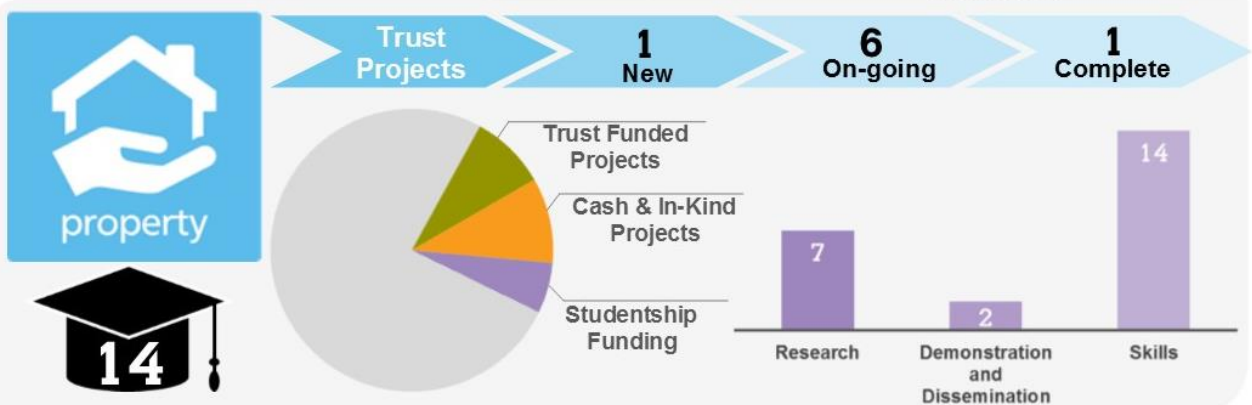
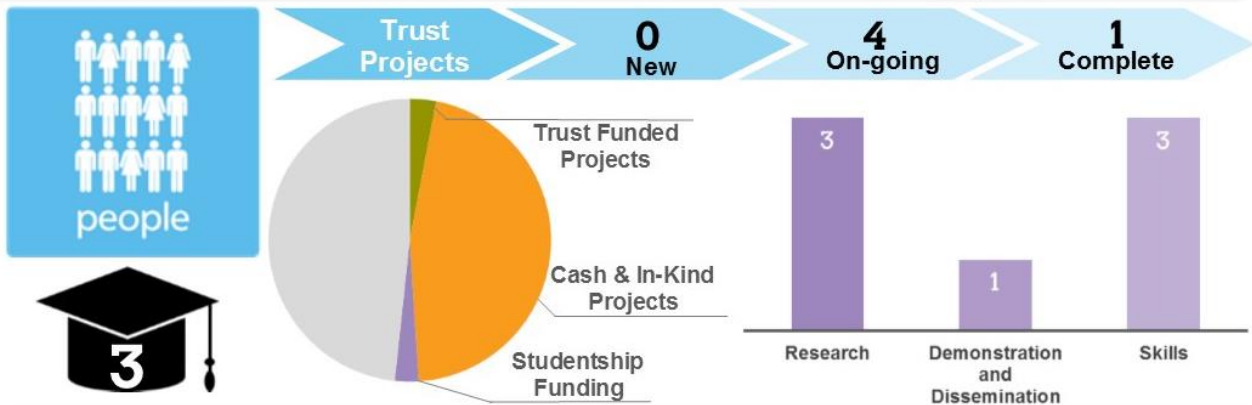


Executive Summary

This quarter...

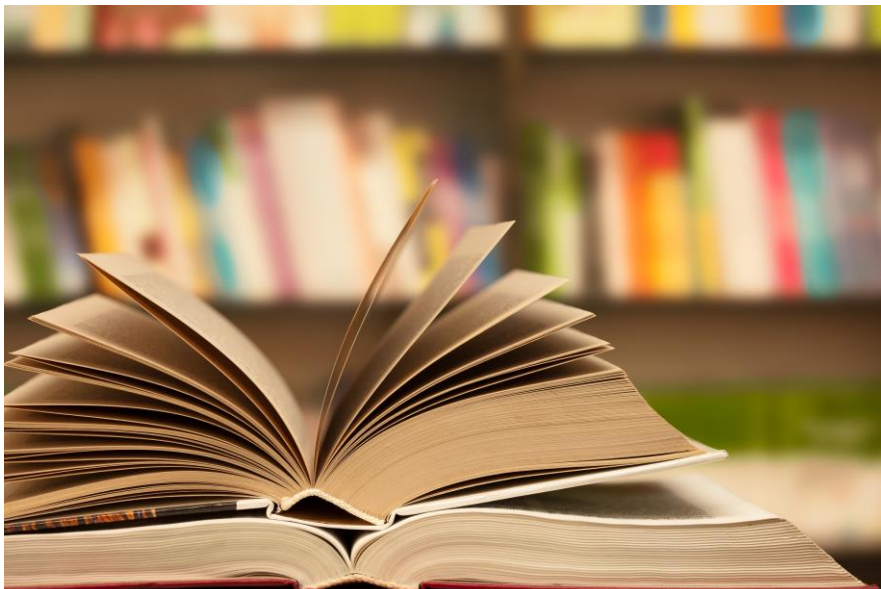


Total Programme Spend
 £1.9m Cash & In-kind
 £1.2m Trust funding



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Focus on Infrastructure

CEEQUAL

delivered by bre

BREEAM Infrastructure (pilot) was developed from several BRE Trust funded projects as well as BRE funded business investment. This included early work to set the core technical standards for the scheme as well as to develop the research behind the materials, waste and resilience sections. In addition, very helpful research to better understand the approach to early stage optioneering and how this relates to the scheme was supported by the BRE Trust, together with important work regarding how to set system boundaries for the various assessments within the scheme. The pilot was launched for use in early 2015. The more science based and outcome focused approach was welcomed by industry. However, there was a call for this to be a single scheme for all to aspire to rather than a new competitor for the established CEEQUAL. As a result, BRE acquired CEEQUAL in November 2015. BREEAM Infrastructure (pilot) now has eight projects including HS2, Tideway and, most recently, the Trans-Pennine Route Upgrade. These projects have benefitted from the advanced sustainability thinking in the scheme. They have returned significant and helpful feedback on the use of the new scheme and this is being fed back into the development process.

CEEQUAL has grown steadily in the just over two years since it joined BRE. The 596 project registrations when BRE acquired CEEQUAL in 2015 has now grown to over 700.

These include major projects such as Crossrail, Thameslink, Queensferry Crossing, Olympic Park, A303 Stonehenge Tunnel, A14 Cambridge to Huntingdon as well as many more modest civil engineering and landscaping projects. While CEEQUAL has grown it has tended to be through a smaller number of larger projects than previously. International take up has increased with Sweden remaining the largest international user and CEEQUAL use extended to include Finland, Dubai and Malaysia since CEEQUAL moved to BRE making seven countries in all. Our strategy has been to operate both the BREEAM infrastructure (pilot) and CEEQUAL version 5.2 in parallel while feeding the learning from both these into the development of the single scheme that will meet industry aspirations. This single scheme will be called CEEQUAL (2018) and it will be launched late in 2018. This brand reflects the fact that the new scheme derives from both BREEAM and CEEQUAL and also maintains continuity for the many client references to CEEQUAL that are present in policy, specification and procurement documentation.

CEEQUAL (2018) will bring together the best of both schemes and will lead the world in sustainability rating of civil engineering projects. It will be true to the needs of those in industry that came to us for BREEAM infrastructure and it will reflect the legacy and interests of the CEEQUAL community and the shared vision that brought CEEQUAL and BREEAM together at BRE.

The first BREEAM Infrastructure (pilot) certificate has been achieved by High Speed Two for the Strategy stage of the project and was presented to them at the BRE Winter Reception in February. This and the other pilots continue to produce good and useful feedback which is being fed into the development of the next version.

As we approach the launch of the new scheme so it becomes less advantageous to register new projects with the pilot. This is because any learning from a new pilot project will be too late to influence the new scheme. Whilst we continue to encourage projects to register and use CEEQUAL version 5.2 we are aware there will be a number of long term infrastructure projects that wish to seek very high standards of sustainability and therefore register with CEEQUAL (2018) when it is launched. In the meantime, however, they want to ensure their strategic stage processes and decision making are in line with best practice and, as far as possible, in line with the requirements expected within CEEQUAL (2018).

To enable this, we have developed a pre-registration process that outlines how projects can achieve this. This pre-registration process will not be appropriate for all projects and we expect many to continue with the familiarity of the current CEEQUAL until the launch of CEEQUAL (2018). While all new registrations from the launch of CEEQUAL (2018) will be to the new version,

projects that have started with CEEQUAL or with BREEAM pilot will be able to continue to completion in those schemes.

Projects that would find benefit from switching to the next version will be able to do so.

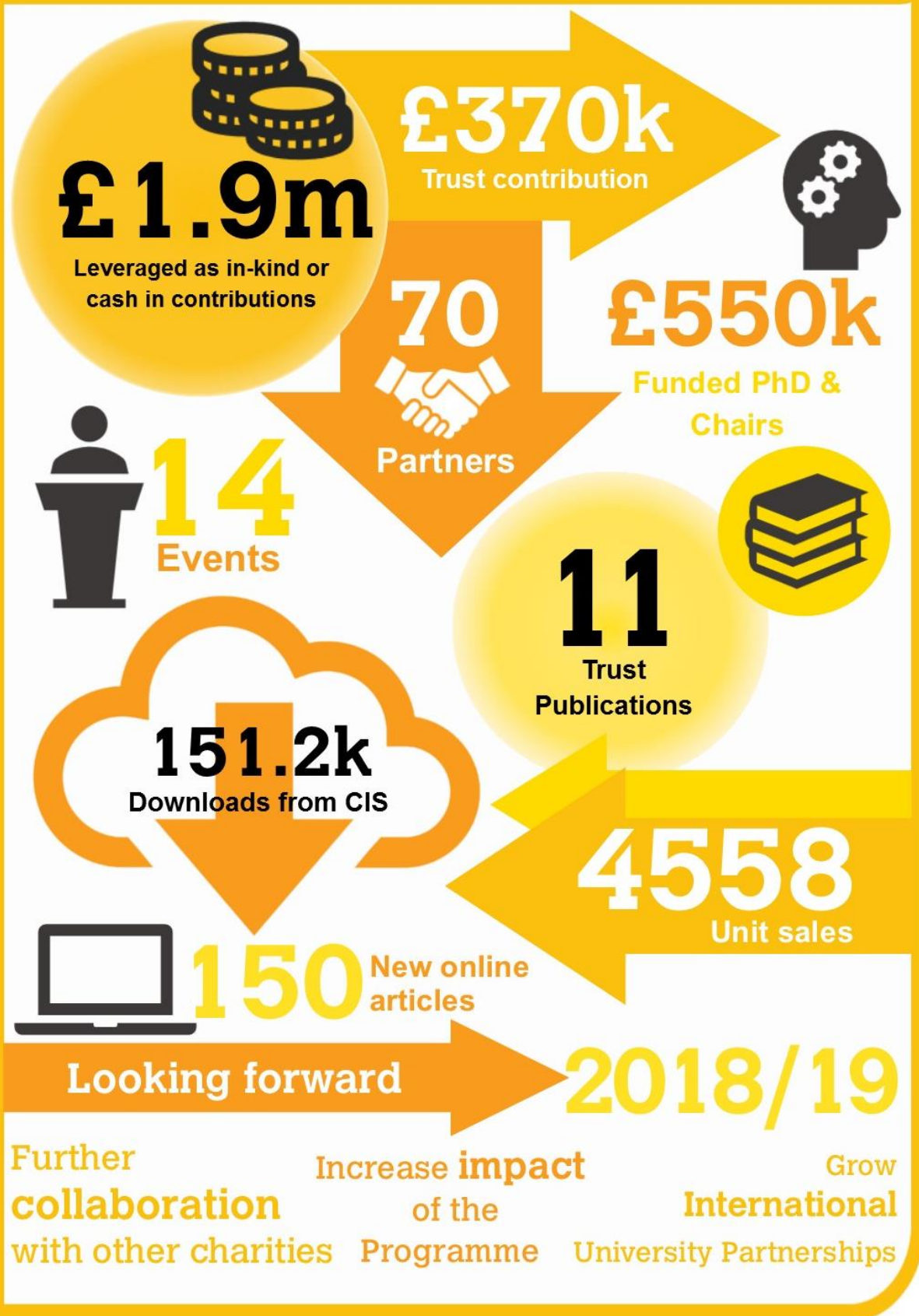
From a training perspective CEEQUAL assessors and BREEAM infrastructure assessors all have skills of relevance to the new version.

CEEQUAL assessors and BREEAM infrastructure assessors will be able to top up their training to the next version when the time comes. We anticipate that those trained in both will need a short online conversion module.

There have been several presentations of award certificates to projects and teams. CEEQUAL makes the most of these opportunities to celebrate the achievements and to talk about the scheme. In the last few months these have included several Crossrail projects; Arlanda airport long term car park in Stockholm; A82 at Pulpit Rock, Loch Lomond; Holywood Public Realm in Northern Ireland; Brooms Cross Road in Sefton and The Avenue coking works remediation project in Chesterfield.



2017/18 Year Summary



Project Progress – People

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

Current portfolio: Trust - £66.5k, Cash - £615.5k, In-kind - £880k

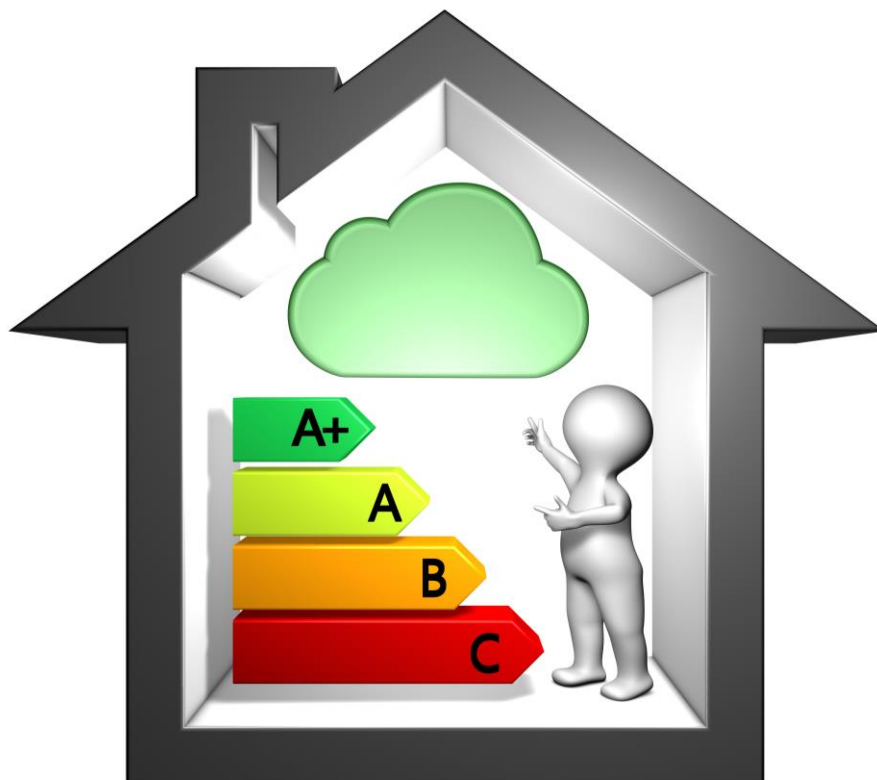
New Project - The life-long health effects of poor indoor air quality

£15k Trust, £140k cash contribution

Links in the media between poor air quality and the effects on building occupants, from irritation and discomfort, to poor performance and mental health issues, to serious disease and mortality, have grown public appetite for solutions to improve IAQ. The RCP (Royal College of Physicians) and the RCPCH (Royal College of Paediatrics & Child Health) published the "[Every Breath We Take](#)" report in February 2016 which emphasised the importance of IAQ. One of its authors approached BRE about undertaking similar work on IAQ together.

A launch event at the RCPCH in London on 12 April 2017 was held with a variety of stakeholders and a working party to deliver the collaborative report was set up. The RCPCH will have overall responsibility for the project, and work with the Working Party, who will advise and carry out key aspects of this work.

Andy Dengel will be on the Project Steering Group for the Working Party, and both Andy Dengel and Colin King will be Working Party members and provide technical and editorial input to the report. The project will culminate in a high-profile authoritative report, with huge publicity and media coverage. BRE will use its range of dissemination and knowledge-sharing channels to communicate on project progress. This work will carry several benefits for the built environment, providing vital learning on the effects of poor IAQ on pre-natal, neo-natal, school age children, and the lasting and life-long effects on health; Wide ranging benefits to public health and the UK's health services; Better spaces and better buildings, due to heightened awareness across many stakeholder groups with regards to the importance of good IAQ - during the course of a lifetime; Playing to what is a multi-billion pound market overall, when the nation's overall health, public finances and construction sectors are considered.



Complete Project – Biophilic Office

£15k Trust, £985k other contribution

BRE are refurbishing B18 first floor into biophilic offices to understand the costs and practicalities and how to quantify the impacts of biophilic buildings. The BRE Trust funded part of the project aimed to develop a research network that will allow the BRE biophilic office refurbishment project to remain a market leader and to grow through the support of PhD students and research organisation collaborations.

A matrix was created to identify existing research expertise with relevance to the BRE Biophilic office project. This helped to form the basis for a new research network, developing the concept of an interactive map to display the identified universities/organisations and facilitate engagement, the production of this map will follow as a next step of this project.

BRE has made contact with several universities to discuss future collaborations around the biophilic project: University of Cambridge, Cardiff University, University of Hertfordshire, Newcastle University, University of Lancaster and University of Primorska, Slovenia.

This project supports BRE's ambition to become a recognised authority on this topic and its contribution to improved health and wellbeing. It has also created new relationships that could lead to additional collaboration and support for the BRE office refurbishment project into the future.

This project is also supporting the development of a conference delivered at BRE focused on health and wellbeing of office buildings (mid 2019). Workshops will also be run with stakeholders to identify gaps in the market regarding needs of office owners and team managers to improve the health and wellbeing of their tenants/staff. The biophilic office demonstrator also has the potential to be used as a testbed for PhD research and is already being supported by a student at Cambridge FIBE.



Project Progress – Property

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

Current portfolio: Trust - £240.4k, Cash - £128k, In-kind - £140k

New Project - Disseminating knowledge through digital training

£40k Trust, £20k in-kind

Using the BRE Academy's ability to reach thousands of professionals this project will seek the support and expertise of BRE colleagues to create materials to form a training programme that addresses identified industry needs focused on retrofit.

As well as engaging with BRE's technical experts there will be interaction with our partnered universities to ensure that this project is looking to the future needs of the industry. A series of online CPD training sessions will be developed on retrofit to raise awareness following the Each Home Counts (EHC) review of domestic refurbishment. These modules will be used to disseminate knowledge more efficiently to a wider audience than previously possible via publication, conferences and classroom-based courses.

The approach also aims to give more insight into which assessment styles are most effective in the delivering of training materials and how to best validate that the learning outcomes have been achieved. Initially this pilot programme will be delivered free of charge and once the methodology is set out and verified the Academy can use this information to take other training programmes forward in this way.



On-going Project – BIM Case Studies

£24k Trust, £22k In-kind

BIM offers huge potential for efficiency improvement, cost reduction and carbon savings during construction and the whole life of an asset. The UK Government mandate required government departments to procure construction projects using BIM Level 2 from April 2016. This has been a significant driver for the industry and BRE is at the heart of subsequent developments in BIM.

The private sector has been slow to adopt BIM, often citing lack of evidence on the benefits, either in procuring construction projects or in the ongoing management of assets.

The purpose of this project is to generate scientifically rigorous and independently assessed case studies on construction projects which have adopted BIM Level 2, to substantiate the claimed benefits made by the proponents. These case studies will cover a range of project types, including public and private sector buildings, housing and infrastructure. The first part of the study, covering this proposal, will look at the capital phase of the projects (design and construction). It is proposed that the study will then continue to follow these projects into the operational phase, which will be subject to a later proposal.

The output of this research will impact across the whole of the sector, by facilitating the adoption of BIM Level 2 and driving towards the Government's targets. The impact is even greater, in that through the creation of better quality, higher performing built assets, there is a multiplier into the benefit delivered to the business and ultimately society.

Completed Project – Blockchain Feasibility

£15k Trust, £15k In-kind

There has been much media attention in recent months on Bitcoin and the Distributed Ledger Technology (DLT) that underpins it. DLTs, of which Blockchain is a version of, can be utilised in many sectors and applications. The aim of this paper has been to shed light on this evolving technology and what value it could bring to the built environment. In doing so various areas of further research within our sector have been identified. BRE convened two workshops with a wide range of interested parties to initially draw out the areas of consideration and application and then to further validate these in the second workshop. This report summarises the discussion and evolution of thought over the two sessions and identifies the areas for further consideration to be:

1. Digital passports
2. Smart contracts
3. Resourcing
4. Connected systems

This paper suggests that distributed ledger technologies may not necessarily offer new methods but can enhance and add rigour/efficiency to systems that are often challenging in project management and delivery. There are technical obstacles to overcome and the realisation that digital ledgers can be private as well as public, some with devolved functions and others that can be directly controlled, requires further thought.

As with many possibilities in business there needs to be clear return and value created; whether this is social, environmental, and economic or to mitigate risk in another sphere and protect/enhance the company reputation. Distributed ledger technologies can create this value and return but should be carefully selected to ensure the technology can be deployed effectively.

The report can be downloaded here:

<http://bregroup.com/wp-content/uploads/2018/02/99330-BRE-Briefing-Paper-blockchain-A4-20pp-WEB.pdf>



On-going Project - Connectivity for Smart Homes

£53k Trust, £63.5k cash contribution

Phase 1 of this project was started in Autumn last year and has concentrated on validation of modelling techniques for Building Path Loss (BPL). A review of measurement techniques to produce a suitable test methodology was undertaken and measurements were taken for a range of frequencies, at a number of heights and incident angles. These were performed on 3 houses on the BRE Campus; the Mansion, Wienerberger House and UserHuis. Statistical techniques to obtain Building Entry Loss values for a range of scenarios was used to process the results. These included looking at the materials used in the test buildings such as; solid brick walls, foil backed materials and properties of different glass used. The findings of these tests have been collated into a report detailing the measurements and conclusion from these results and delivered to the project partner.

A summary of the results will be published in a journal and a paper submitted to the International Telecommunications Union (ITU) that lead internationally on the development of Building Entry Loss models.

The next step is to review modelling techniques, the range of modelling techniques and tools available will be evaluated; both technically and cost considerations, to determine the likely benefits and limitations for a range of scenarios. Available CAD/BIM models will be assessed to identify what translation is required to allow them to be used for modelling tools.

Once the tools and the CAD/BIM Models are tested and verified the modelling will be undertaken on the same three houses, and covering a wide range of scenarios. The data obtained will then be processed using the same statistical methods used for the measurements. The findings will be summarised in to a report before moving on to the final stage of the project due to end in March 2019.



Project Progress – Places

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

Current portfolio: Trust - £12k, Cash - £121k, In-kind - £24k

New Project – QSAND & Redevco Foundation collaboration

The new phase of development and delivery of QSAND has begun, with the following work plan agreed:

QSAND application: We are working with our partner CRS to develop:

- a case study (interim stage application) about QSAND in Gorkah in Nepal (disaster was an earthquake in 2015)
- a case study review of QSAND carried out on a project in Tachloban in the Philippines (disaster was a typhoon in 2013)

Partnerships: We are exploring partnerships with development organisations in:

- Middle East for possible application support projects in Sudan and Jordan
- Spain for possible application support projects in Peru and in other locations in South America

Partnership and application support is actively taking place focused on the following areas: Caribbean, Asia, Africa and South America

Other: Humanitarian demonstration shelter

- Cases study in development with CRS
- Page now available on the BRE Innovation Park
- Work on going to develop interactive learning activities for visitors



New Project – Article 25 collaboration

A new research project which will assess the effectiveness of a new roof design concept being used in a number of school buildings delivered by Article 25 is being defined. This will involve BRE and also The University of Bath, and the identified test site the Gourcy School in Burkina Faso. The project will assess indoor temperature, humidity and air flow at various locations in the building as well as monitoring equivalent external conditions over a period of time.

The consortium are keen to then seek external funding to create a laboratory environmental test rig which would allow representative structural elements a range of conditions to be simulated to assess the effectiveness of the design in different climatic conditions in developing countries. This project will be a valuable learning environment for BRE and Bath, giving wider understanding of the ability of simple passive designs to support environmental comfort in extreme weather environments.



Outreach & Dissemination Activities

2017/18 outreach – Year to Date

Publications – 11 Titles Sales – 4,558 units Downloads – 151,219 Events – 14 New Articles - 150

Sales & Downloads

Sales and downloads have remained consistent with those of last quarter and of the same quarter last year, bringing the annual total to over 155,000 units. The majority of these being downloads from CIS (Construction Information Service). These users have mainly looked at ground engineering and related subjects as well as the Expert Collections, 8 of these appear in the top 30 downloads, 3 in the top 10. There have been 2 bulk sales, each of 100 copies, putting the following titles in to the best sellers list for this quarter:

- BR453 Recognising wood rot and insect damage in buildings
- FB11 Modern methods of house construction – a surveyor's guide

Other titles that feature in the top 10 are BRE Digest 365: Soakaway Design and BR211: Radon: guidance on protective measures for new buildings.

Outreach

The Academy is continuing to develop training courses, particularly on-line material through the Academy's digital team. During 17/18, 8 new courses were produced and over 60 webinars were delivered. Work in the last quarter has been concentrated on developing the BREEAM New Construction training (both classroom and on-line) and updating BIM Essentials. Recent highlights include becoming an Approved Training Organisation (ATO) with CITB which enables the Academy to deliver training in accordance with CITB standards. This means that grants are available for organisations which take these courses. With the BIM team, the Academy is also delivering BIM training to the Strategic Estates team of the Houses of Parliament.

BRE Bookshop

Increasing 18% since quarter 3 there were over 40,000 hits on the BRE Bookshop website, although an increase on last quarter this is a significant drop of 32% on the same period last year. Page views have also decreased substantially by 39%. With traffic to the website continuing to slow down new routes to disseminate any or all BRE Trust activities must be found.

Dissemination

BRE Trust Website

The new look BRE Trust website is now live and can be found at; <https://bregroup.com/bretrust/>

There you will find a host of information on past and current Research projects, including information on our University Partners and sponsored PhDs.

The performance of multi-sensors in fire and false alarm testing

The briefing paper to accompany the Trust funded research project was released in March. The findings of these project have been summarized in the report which can be found as a free [download](#) from the BRE website.



Constructing Excellence National Award winners – 2017

Each year 8 Constructing Excellence regions run awards to uncover the very best practice across thirteen categories. The winners at a regional level go forward to national awards in November each year. Two outstanding winners from this year's awards are:

Innovation Award – arcoBridge, Arup, South West

arcoBridge is the world's first modular glass fibre reinforced polymer (GFRP) posttensioned pedestrian bridge. It has been designed by Arup and has the potential to transform the construction, installation and customisation of pedestrian bridges deployed by the rail, highways, water, local government sectors and beyond.

The use of GFRP makes this bridge 70% lighter than a conventional steel span and provides additional resistance to fire, graffiti, vandalism, and ultra-violet radiation. It can be assembled on site rapidly by hand without the need for specialist tools or adhesives and it can be transported by articulated trucks negating the need for heavy machinery, such as cranes. An arcoBridge is fully customisable and is expected to last approximately 120 years.

The arcoBridge concept emerged from a discussion at a teapoint between two structural engineers working in Arup's Bristol office recognising that

there was a growing need within a range of sectors for lightweight, easily producible structures. It has been many years in development but more recently Network Rail's requirement for the replacement of a significant number of level crossings. This prompted the team to develop the design further with Network Rails specific needs in mind.

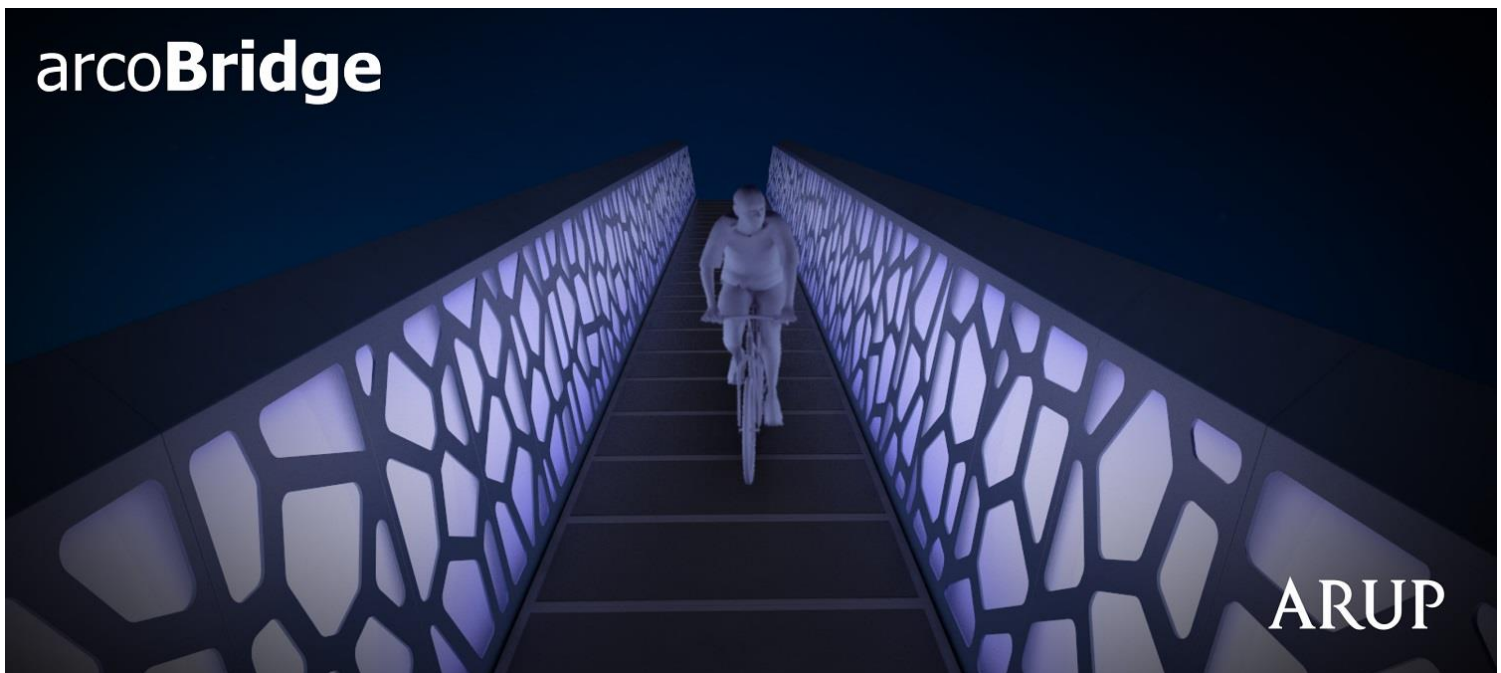
Arup felt a need had emerged for an entirely new type of footbridge one that would be lightweight and capable of being installed quickly and easily, without the need for lengthy and costly rail line possessions.

The team also engaged with the UK Rail Safety and Standards Board (RSSB), which felt the concept had strong potential. They contributed financial support to ensure product development continued to the stage that would allow for a demonstrator project in full compliance with footbridge standards.

The range of possible applications for arcoBridge is only beginning to be explored, but it is already clear that the design will be applicable for sites subject to flood risk, remote sites, sites where a heavier structure could not be borne due to ground conditions or where damage to sensitive habitats would be excessive. This represents an innovation with genuine potential to transform the pedestrian bridge market across the EU and, likely, beyond.

Link for images:

<http://constructingexcellence.org.uk/arup/>



Project of the Year Civils – Leeds Flood Alleviation Scheme – Yorkshire and Humber

The first phase of the Leeds Flood Alleviation Scheme reduces the flood risk of over 3,500 residential and commercial city centre properties and has created 150 direct jobs and safeguards 22,000 more over the next 10 years.

The scheme includes three principle elements:

- Linear defences comprising masonry clad concrete walls and glazed panels along the river
- Innovative moveable weirs at Crown Point and Knostrop which can be lowered in flood conditions
- Removal of an island between the river and adjacent canal along with targeted dredging to increase capacity within the river

One of the key components of the project was the replacement of existing fixed Victoria weirs at two locations with innovative mechanical weirs, placing Leeds at the cutting edge of national flood defence schemes. The new moveable weirs allow a significant reduction in the height of the high quality walls and embankments, which together with terracing and landscaping maintains physical and visual connectivity with the waterfront.

BMMJV also delivered an extensive programme of community engagement throughout the project, exceeding the targets set by Construction Housing Yorkshire (on behalf of Leeds City Council). This includes;

- 18 apprentices working on the job for a combined total of over 650 weeks;
- 14 new direct employment opportunities created for people from Leeds postcodes (and 32 more to people living outside of Leeds);
- 41 weeks of work experience completed;
- 45 educational workshops held;
- Engaging with local charities, resulting in donations totaling more than £3000.

Proactive management of stakeholders and neighbours has allowed the project to be undertaken with no significant complaints. Proactive management was a resounding success at Crown Point weir which is overlooked by circa 600 apartments and has involved heavy piling works. A bimonthly newsletter and project specific twitter account were used to communicate progress and advise of upcoming works, in addition to regular letter drops to nearby effected buildings. Early consultation with local businesses allowed us to re-programme some works to tie in with businesses being refurbished or vacated by occupants minimising the amount of disruption.

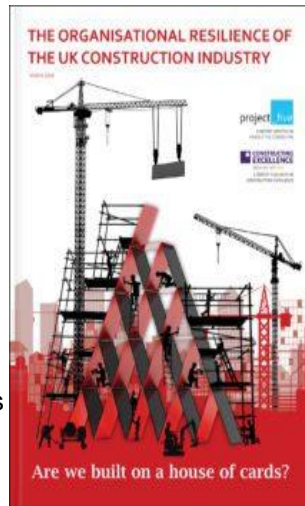
Co-location of the client and their advisors, the Environment Agency, Arup and BMM JV team on site lead to strong relationships being developed and problems resolved quickly by all the relevant decision makers working together.

<http://constructingexcellence.org.uk/leeds-flood-alleviation-scheme/>



Organisational Resilience – Are we built on a house of cards?

In the wake of the Carillion collapse, constructing excellence published a report that reveals almost half (43%) of construction firms prioritise immediate financial goals over organisational resilience. The report reveals the key obstacles to embrace organisational resilience, identified among the 100 senior business managers and executives within UK Construction Organisations surveyed are:



- Immediate financial goals are more urgent – 43%
- Inadequate budget – 27%
- Lack of skills or knowledge related to ensuring resilience/business continuity – 27%
- Insufficient senior management focus on resilience – 19%
- Opaque operations or practices, making the effects of organisational actions towards increased resilience unclear – 14%
- 29% stated they didn't see any obstacles.

The purpose of the report was to provide an overview of how resilient the industry is in relation to a range of internal and external factors. It explores the role of organizational resilience in enabling construction companies to adapt to changing conditions.

The report, written by [Project Five Consulting](#), has identified the construction industry as a key enabling sector for the wider UK economy. A resilient sector should be good for UK plc. However, it has a higher rate of failure than the average across all industry sectors. This fragility is underpinned by structural issues that characterise the weaknesses in the industry. These are borne out by the recent collapse into liquidation of the country's second largest construction company, Carillion.

Twitter

The @TheBRETrust Twitter account has been used for various promotions this last quarter including the Engineers Trust Hawley Award that is coming to an end during next quarter. The platform has also been used to highlight the release of the BRE Trust Quarterly reports on the BRE Trust Website <https://bregroup.com/bretrust/about/quarterly-review/>

Digital Reports

Two new digital reports have been produced this quarter. One to complement the focus of this report; Infrastructure and the other concentrating on the partnership between the Trust and Article 25, specifically around Tim Wiseman's cycle tour of Myanmar and the Kyel Sin, the Burmese architecture student the BRE Trust supported to join the expedition in November 2017. These can be found on the BRE Trust Council Members Sharepoint site.



Designing Buildings Wiki

By the end of the 4th quarter there were 6,597 articles on Designing Buildings Wiki of which 285 of these are from BRE. 27 new articles were published in the last quarter and cover topics such as Concrete, BIM life cycle assessments, BREEAM, Fire and a feature of the recent Blockchain project that was carried out with Trust funding. This content was viewed 21,777 times in this period with top articles including:

- BREEAM
- BRE Digest 365 Soakaway design
- The daylight factor
- Fire performance of external thermal insulation for walls of multistorey buildings, third edition (BR 135)
- Automatic fire detection and alarm systems, an introductory guide to components and systems BR 510

The locations of users accessing BRE articles during this quarter were:

- | | |
|------------------|-------|
| • United Kingdom | 66.5% |
| • United States | 3.8% |
| • India | 3.7% |
| • Ireland | 2.1% |
| • Malaysia | 1.7% |
| • Philippines | 1.4% |
| • Australia | 1.2% |
| • Canada | 0.9% |
| • Hong Kong | 0.7% |
| • Netherlands | 0.7% |
| • Other | 17.1% |

An interesting worldwide spread but not surprisingly the majority are from the UK.

A new microsite was also launched – BREEAM Wiki. This is a centralised library of best practice created not by BRE but by users and other key stakeholders of the BRE sustainability assessment tool.

BRE Buzz

The online platform has been utilised to extend the outreach of BRE's articles and blogs. In the last quarter there were 33 articles, with 1 being Trust related. The article, 'How a BRE office became the centre piece for major Biophilic Design research' focusses on the story of how the research project came about and a brief overview of what it will entail and the hopeful outcomes. The office in question is currently in the pre-refurbishment monitoring phase and the design plans just starting.

This article attracted over 127 views which is significantly down on last quarter, where there were 90% more Trust articles published. The whole site received 15,079 visits, an increase of 24% since last quarter (12,083) this substantial rise is probably due to the BREEAM Awards that took place in March and a number of articles that have been written about the winners drawing attention to the industry.



Schools Programme

The project in collaboration with EDT (Engineering Development Trust) came to a conclusion this quarter with a Celebration and Assessment Day held at the University of Hertfordshire. Kristin Coldwell, Stanborough Schools' lead teacher on this project has written a review on their experience:

"A team of six Year 12 students from Stanborough have been working intensively on a real-life engineering project for the last six months with the support of BRE; their efforts were recognised last week at the regional Celebration and Assessment Day at the University of Hertfordshire. Tawsif Choudhury, Callum Elliott, Hamzah Hussain, Christopher Illes-Wilbourn, Hannah Imafidon and Joseph Lowton began working on the Engineering Education Scheme when they attended the scheme's launch event at BRE Watford back in October 2017. The BRE Trust sponsored the team project which was based on "Automated House Construction for the Future." John O'Brien, Associate Director of Construction Innovation at BRE introduced the project to the team, and an initial tour of the Innovation Park sparked the imagination of the six students. They worked tirelessly from that point, researching existing products, generating new ideas and analysing the effectiveness of their proposed solutions, all supported by Dr Deborah Pullen, Group Research Director, BRE who attended many of their weekly meetings and was

available via email at other points.

In December, progress on their project was given a boost at the Residential Workshop in Cambridge. Over the two days the team had focused time in the University's Faculty of Engineering to construct and test models with the expert advice of both Deborah Pullen and Monika Munzinger, Research Programme Manager at BRE. This allowed them to finalise their design as well as getting an experience of student life, staying overnight in St. Catherine's College.

A further visit to the BRE site in February was followed by a sustained and concerted effort to complete the final model for the team's chosen design as well as the report, presentation and display stand ready for the Celebration and Assessment Day. The hard work paid off and the assessors at the University of Hertfordshire were full of praise for the team's innovative concept, their comprehensive report and their confident presentation. As well as presenting formally to a panel of assessors, Stanborough's team talked knowledgeably to a wide variety of guests who visited their display stand and they also had the opportunity to view other school's projects. The day finished with their graduation as Gold Level Industrial Cadets. This outstanding achievement has been beneficial to them personally in terms of organisational, teamwork and leadership skills, and will also help them to be recognised by universities and employers and to progress in their chosen fields of study and careers."

Kristin Coldwell, KS5 and G&T Leader, Maths Stanborough School



Events

Innovation Park Partners Network

BRE hosted the first Innovation Parks Network Convention on 5/6 March 2018. The purpose of this event was for Innovation Park partners to share experiences in developing Parks around the world, and to discuss ways in which greater collaboration could be undertaken across the Network.

The event was attended by 130 delegates across the two days of the Convention. Representatives from the UK, Brazil, Canada, Chile and China were present, and were joined by delegates from the Netherlands, Estonia, USA, and Ireland.

Delegates discussed common priority themes which could be tackled collaboratively across the Innovation Parks Network. The three identified themes were as follows:

- Health and wellbeing – including ageing population
- Resilience – including climatic, energy and societal
- Knowledge and information sharing.

Each of these themes now has a activity programme and lead coordinator attributed to it. This will create a platform for greater collaboration across the Innovation Parks Network and demonstrate value to all of the partners involved.

ECI & Operating System 2.0

On 21st February 2018 over 60 high level representatives of ECI were joined by colleagues at CII (Chartered Insurance Institute) at the offices of Fluor in Amsterdam to debate *Existential Crisis – Rethinking how capital programmes are delivered*.

Delegates were welcomed by John Fotherby, Chair of ECI and Arne Siewertsen, DM Project Controls & Estimating at Fluor. Paul van Weert, Shell Global EPC Manager and Bernd de Jonge set the context for a sector that needs to change. Discussed was the need to halve the costs of capital projects to enable them to do twice as many projects with the same allocated budget, not through putting more cost pressure on supply chains, but through fundamentally rethinking the delivery model. From a client perspective they want to see more continuity and learning across projects,

greater standardisation and higher levels of collaboration. The case was made for making capital programmes more affordable, investable and bankable through better utilisation of capital. It was proposed that more R&D, greater use of digital technology and more collaboration were the keys to delivering projects more effectively. These topics will be further explored at the ECI Members forum going forward.

Cambridge University FIBE visit

A group of staff and students from the University of Cambridge EPSRC Centre for Doctoral Training in Future Infrastructure and Build Environment visited BRE on 19th March 2018. A total of 15 attended and the purpose was for them to better understand BRE and its facilities in order to enhance current and future industry engagement on projects.

The group was welcomed by Deborah Pullen, BRE Director of Research who explained BRE and its approach to research. Chris Broadbent, Director, CEEQUAL and BREEAM Infrastructure talked about the range of expertise and tools provided by BRE and in particular those relating to civil engineering and infrastructure. During the visit Peter White provided a detailed and informative tour of the BRE Innovation Park and other facilities including the structures laboratory, wind tunnel, sound transmission suites and anechoic chamber and the Möhne Dam. He also explained BRE's fire testing facilities.

There were opportunities for students to discuss with BRE particular projects in which industry engagement is taking place. The visit was a good opportunity to demonstrate the possibilities for BRE and FIBE-CDT to work together in the future.



BRE Innovation Park - Watford

ENBRI Meeting – Madrid

The European Network of Building Research Institutes (ENBRI) has 22 members, including BRE, that represent building research institutes in Europe. The board meet twice a year to discuss research and development in the built environment at national, regional and European levels. ENBRI works with the European Commission and stakeholders of the European Construction Sector in order to contribute to the improvements of competitiveness, sustainability, quality and safety of the built environment.

Deborah Pullen, BRE Group Research Director, accompanied by Katie Plumridge, Research Graduate at BRE, represented BRE at the ENBRI board meeting on 20th April in Madrid. Each institute representative provided updates on exciting developments within their respective institutes, these included; The IETcc-CSIC, from Spain, announced their progress in gender equality, with the development of a new permanent role to ensure equality within their institute; RISE spoke about their on-going developments in autonomous trams in Sweden; TNO, from the Netherlands, highlighted their research in the possibilities of wearable exoskeletons that combine human intention and mechanical strength to enhance human performance at work;

EMPA, from Switzerland, spoke about their new 'Urban Mining & Recycling' unit that demonstrates a residential modular build constructed from reusable, recyclable and compostable materials. Members highlighted projects for potential collaboration amongst the member institutes and areas that require further research through formation of working groups in topics such as BIM, Indoor Air Quality and Acoustics. The next ENBRI meeting will take place in November alongside the ECTP Conference in Brussels.

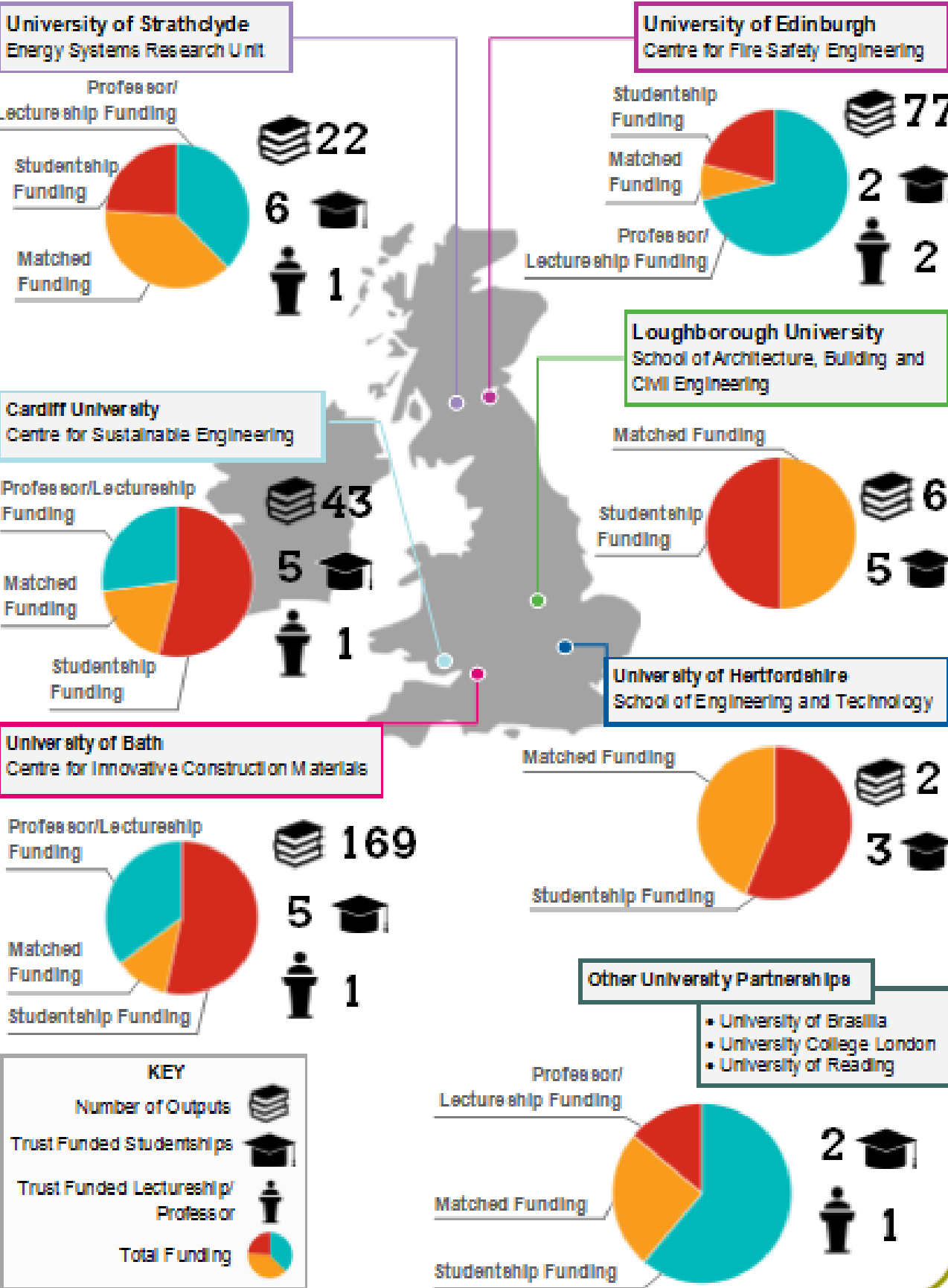
Ecobuild

In March the BRE Academy delivered a number of Quality and Performance in Construction Workshops at Ecobuild. The 3 day programme featured a number of topics and projects that have benefitted from Trust funding, both past and present:

- QSAND – Yetunde Abdul
- BREEAM Infrastructure – Chris Broadbent
- Indoor Air Quality – Dr Andy Dengel
- Biophilic Design – Ed Suttie
- SABRE – Gavin Jones



University Summary 2017/2018



Partnership Programme

Academic Partnerships

BRE has partnered with the University of Hertfordshire (UoH) in the delivery its Civil Engineering degree (BEng/MEng). This quarter the Academy has supported UoH in preparing for a visit from the JBM (Joint Board of Moderators) who can accredit the course and are looking to visit BRE in early 18/19 as part of their assessment.

The Academy is also helping Oaklands college (University College of St Albans, UCSA) on its Construction Management BSc. During this quarter the students have visited BRE as part of their construction innovation and technology and have used the Innovation Park as a vehicle to cover a range of topics including offsite construction, innovative materials, performance gap and airtightness which culminated in a blower door test on the Prince’s Natural House. The BRE Trust continues to engage across the university sector and are embedding the BREEAM and BIM AG (Approved Graduate) qualifications into various university courses. BREEAM AG provides a good foundation for students working in construction, its interaction with BREEAM and is a first step to becoming an assessor or an approved professional. Successful completion of the BIM AG course provides the basis for students to be certified

Loughborough University

The BRE Trust is providing part funding to three new research projects. One is an extension from an MSc study that used the 2011 EFUS (Energy Follow Up Survey) data provided by the Building Performance Group in BRE. This project will further explore the methodologies and analytical tools used to carry out the verification and solutions to some of the queries in existing housing stock performance analysis, closely in line with the objectives of the business unit.

Building Energy and Environment: measurement, data, analysis and interpretation

The students’ work has two phases, firstly towards an MRes and then PhD. For the MRes dissertation, a literature review and exploratory work using the 2011 EFUS data will be undertaken, to understand what insights might be possible through the application of advanced analytical methods using tools such as MATLAB and SPSS. This will help to answer possible example questions such as, is it possible to split heating and hot water gas use; if the model can identify the appliances that are contributing most to electricity demand; the possibility to reconstruct the patterns of heating in homes, the accuracy and if the information extracted conform to the established understanding of these matters.

The key thereafter, in the PhD phase, is to understand what causes high energy demand; to separate the effect of the built form (house type, geometry and energy efficiency) from the socio-economic factors; and to understand how patterns of demand have changed since 2011.



Improving overheating risk assessment procedures in urban dwellings

The purpose of this PhD is to understand the relationships between urban dwellings and their energy efficiency; the sources of heat gains; overheating risk, indoor temperature and indoor air quality; as well as the effect on occupant well-being (including morbidity and mortality). As part of this, researchers will monitor newly completed dwellings in an urban context in order to investigate sources of excessive internal heat gains and identify opportunities for reducing overheating risk.

The researcher will assess existing overheating risk assessment methods and develop proposals for new methods that can enable more robust predictions and assessment of risks. Outputs of this work will include journal and conference publications and dissemination workshops. This is likely to inform the standards for overheating risk prevention, such as Part L and Part F and CIBSE guides as well as helping to evolve existing BRE tools and methodologies such as SAP, BREEAM, and the Home Quality Mark in relation to how overheating is modelled and assessed.

Blockchains for traceability assurance

One of our existing PhD projects (co-funded, and co-supervised by the BRE Trust) focuses on traceability in construction. There is growing interest in being able to track and trace products and the information about them through global, complex supply-chains, yet the literature on traceability is varied, imprecise and remarkably confused. Moreover, no one has yet made a research connection between this problem (i.e. construction products supply chains) and a potential management solution (blockchain technology -BCT). There is fast-growing public awareness of BCT, and its potential to influence, or even disrupt current financial or other transactional models within business. Emanating from bitcoin technology (distributed/hyper-ledger and cryptocurrency), blockchains are customised, transaction exchange mechanisms which are secure and immutable.

A study by BRE Trust identified potential for BCT in digital material passports, smart contracts, and resourcing and connected systems, and its relevance has been recognised by research leaders. There is an immediate research need to understand and evaluate BCT, and identify possible exploitation options, for the built environment sector, and specifically construction supply chains, while building on the original theoretical work we have already completed on traceability.



Bath University

Two studentships started in CICM Bath University October 2017.

Ahmad Wadee - Optimising phase change material use for energy-efficient buildings

Developing innovative energy-efficient and low/zero-carbon materials are key areas in which the building sector can meet carbon reduction targets. A possible solution is to use phase change materials (PCMs). These are the chemicals that can control temperature fluctuations and increase thermal mass in buildings due to their ability to store and release thermal energy during phase change processes (melting and freezing). This type of material, with the means to fluctuate temperature inside the building can therefore decrease the energy demand, reducing energy costs associated with heating and cooling buildings.

Ahmad's research will develop methods of encapsulating PCMs and incorporating them in to the built environment. One existing method soaks commercial lightweight aggregates (LWA) in PCM. Therefore, the amount of PCM that the LWAs can host is limited by the latter's absorption capacity, which is currently low. Researching more efficient ways of using this process by obtaining an optimal mix and designing construction materials, which will reduce energy requirements to heat and cool both new and existing buildings is key. One way of doing this is to use highly porous granules, made from widely available by-products, which will host the PCM. Ultimately, the novel granules containing PCM could be incorporated into the built environment via panels in new buildings or as a render mortar as a retrofitting solution. The compatibility between granules and matrix; as well as thermal performance and other key properties will be investigated.

Ahmed has also presented an overview of the work to the dCarb department at the University of Bath; and carried out some initial laboratory tests on materials such as, aerated concrete and perlite. This includes water absorption tests and bulk density test of the materials.

James Bradford --- Next generation natural fibre reinforced geopolymers

This project will be mainly experimental and will combine material science and building physics methods. However, it will get input from parallel research which will be modelling the behaviour of these materials in the built environment. This will allow to improve the performance of the target

construction materials which will improve people's wellbeing by increasing thermal comfort for occupants in buildings and reducing energy demand in buildings.

It is expected that this research will produce enough outputs for several peer-reviewed papers in high impact academic journals, trade journals and potential recommendations for stakeholders via BRE publications. Additionally, the findings will be presented at international conferences and broader audience events.

The aim of this project is to transform our use of conventional fibre reinforced materials by using alternative low carbon materials and innovative manufacturing methods. This will deliver the next generation of sustainable, low carbon, fire resistant, creep resistant composite structures. Conventional fibre reinforced polymer (FRP) composites use resins (such as polyesters or epoxies) and fibres (aramid, carbon), both based on fossil fuels. This project will investigate the use of natural alternatives; geopolymers (based upon metakaolin, silica or sol-gel) combined with treated natural fibres, to produce composites with very low embodied carbon.

Since the start of the research in October 2017, which predominantly involved the search and study of relevant and critical literature – focusing on the geopolymer resin - to find gaps in current knowledge and develop a testing plan to generate elucidation. Preliminary tests and procedures were undertaken to form an understanding of resin characteristics and allow optimisation of processing prior to extensive testing. In addition, the knowledge acquired through the study of literature is currently being constructed into a concise review report. James has also carried out additional refinement of the literature review, ensuring all relevant resin related literature was collated and analysed appropriately, as well as carrying out a broader literature search encompassing geopolymer composites and their reinforcing fibres. Progress has been made in the laboratory with extensive resin testing underway with the aim of understanding resin theory and developing a suitable resin to be used with natural fibres.

University of Reading

In the last quarter, Rosalie Callway from University of Reading passed her viva and completed her PhD successfully. During the past three years she has published 2 papers, given numerus presentations and attended the conferences to disseminate her research outputs.

Rosalie's research project has examined BREEAM Communities, a sustainable neighbourhood standard; an assessment scheme in the BREEAM family. The research focuses on the evaluation of one issue from the standard, green infrastructure (SE11), through an empirical study of six UK neighbourhood developments. Three of the sites have used BREEAM Communities and three have not. The research asks whether and how evaluative activities are used to inform and shape masterplan design and construction decisions relating to green infrastructure. It aims to make the role of evaluative practices more explicit and clarify the intentions and experiences of different interest groups in the process.

The findings contribute to research regarding the standardised evaluative frameworks, it also points to the limits of BREEAM Communities in a dynamic and collaborative masterplan process, where the findings will be used to make recommendations specific to BREEAM Communities,

for green infrastructure evaluation and master planning in general. Four further potential areas of research have emerged from this study, including: testing the findings with a wider construction sector audience; incorporation of green infrastructure in the formal masterplan evaluative practices; encouraging greater transparency in financial evaluations and changing the mimetic culture regarding evaluation to increase a sense of evaluative responsibility during construction phases.

Rosalie's work also extended the research outcome from another PhD student, Lewis Sullivan, and provided further steps to carry out verification and enhancement.

Lewis was also sponsored by the Trust and graduated in 2014. His research has indicated there has been minimal empirical examination of these reported benefits or of the costs and challenges of enacting the standard. This is in part because BREEAM Communities is still relatively new (the last revision was in 2011) and because masterplan processes are long term, lasting 20 years or more, making any evaluation of outcomes an extended longitudinal exercise. Despite these research problems it would be valuable to examine how BREEAM Communities and masterplan evaluation are applied in practice; to look at how the standard evaluation and wider masterplan processes are perceived to interact and consider whether BREEAM Communities actually plays a role in shaping design decisions and has any effect, regarding what is ultimately constructed.

School of Built Environment University of Reading

Examining evaluation in sustainable neighbourhood masterplanning

Rosalie Callway, Prof. Tim Dixon, Dr. Dragana Nikolic

Introduction

This study seeks a better understanding of standardised evaluative practice in sustainable neighbourhood development

Rationale and method

BREEAM Communities is a UK-based standard that aims to promote sustainable communities through encouraging developers to apply a standard evaluative framework in the design-phase of a masterplan process. Few studies have examined the content of the standard in relation to the narratives around urban design and masterplanning practice. A literature and case study review have been applied to offer insights regarding the reported benefits and challenges facing the standard (Box 1), and the strategic role it might play in shaping neighbourhood masterplan processes.

Box 1. Benefits and challenges for BREEAM Communities

Reported benefits

- Better integration:** linking sustainability requirements into procurement and design processes
- Cost savings:** optimising the development's sustainability performance, avoiding costs of late design changes and smoothing the planning application process
- Non-prescriptive:** Achieving target rating without undue impacts to flexibility of design decisions, budgets and potential solutions
- Reputational benefits:** independently verified certification improving organisational transparency and credibility (avoid 'greenwash')
- Sustainable neighbourhoods:** benefits to certified neighbourhoods and encouraging market uplift as competitors adopt similar practice

Reported challenges relating to technical structure and application

- Missing sustainability concepts:** emerging or dominant concepts such as financial viability, resilience or circular economies are lacking
- Procedural inconsistencies:** varying application of principles e.g. community engagement and standardised issue weighting, lack of ex-post validation
- Design to construction transition:** site design can be subject to change well beyond the design phase, potentially impacting site sustainability 'performance'
- Complexity:** potential conflicts between differing design and sustainability intentions are not addressed e.g. security versus permeability
- Market context:** many developments may be a smaller scale than BRE considers viable to assess. Market volatility may affect the rate and numbers of large-scale developments taking place
- Policy context:** only three UK councils require the use of BREEAM Communities (Bristol, Eastleigh and Swindon)

Unpacking evaluative practice

An empirical examination of six UK development sites is being applied to review the practitioners, practices and 'praxis' (enactment of practice) involved in the masterplan journey, to seek to better understanding of evaluative activities in the process (Fig.1 and 2).

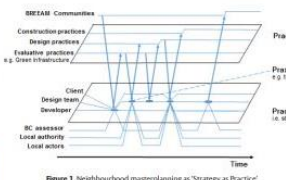


Figure 1. Neighbourhood masterplanning as 'Strategy as Praxis'



Figure 2. Palmerston Road, South Acton estate, Ealing, London
Source: Google map photos, top photo in 2008 & bottom in 2015

Green infrastructure lens

The case study review examines evaluative practices through the 'lens' of green infrastructure evaluation as a means to consider the challenges facing collaborative masterplanning and BREEAM Communities, including complexity and synchronicity across site objectives (Fig.3).




Figure 3. References to Green Infrastructure (GI) in BREEAM Communities

Next steps

Early empirical findings point to the dynamic and transactional nature of evaluative practice and practitioners, boundaries and varying degrees of embeddedness within masterplanning. Wider sector consultation will be applied to consider how generally relevant these emerging insights may be and the potential implications for the future application of BREEAM Communities.

References

- Jones, S. et al (2015) Tomorrow's City Today: Prospects for Standardising Sustainable Urban Development. University of Westminster Excellence project.
- BRE (2011) BREEAM Communities: Technical manual. Building Research Establishment.
- Whittington (2006) Completing the Praxis Turn in Strategy Research. Journal of Organisation Studies, 27 (5) 643-654
- Carmona, M. et al (2010) Public places urban spaces: dimensions of urban design. Routledge, 2nd ed.

Acknowledgements

Thanks to BRE and BRE for their generosity with this project!

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Appendix A: Project Status

People

Research

- Fire Protection: Digital Technologies & Personal Wellbeing. **Trust Contribution** - £12.5k. **Other Contribution** - £60k. **Status** – In progress
- Biophilic Project. **Trust Contribution** - £15k. **Other Contribution** - £985k. **Status** – Complete
- Multisensor detector capabilities and comparative performance with smoke detectors. **Trust Contribution** - £9k. **Other Contribution** - £163k. **Status** – Completed
- Life-long health effects of poor indoor air quality. **Trust Contribution** - £15k. **Other Contribution** - £135k. **Status** – In progress

Demonstration & Dissemination

- Home for Life. **Trust Contribution** - £15k. **Other Contribution** - £135k. **Status** – In Progress

Property

Research

- Suppression of Biomass Fires. **Trust Contribution** - £5k. **Other Contribution** - £40k. **Status** – In Progress
- Centre for Smart Homes. **Trust Contribution** - £53.5k. **Other Contribution** - £64k. **Status** – In Progress
- Blockchain Feasibility and Opportunity Assessment. **Trust Contribution** - £15k. **Other Contribution** - £15k. **Status** – Completed
- Circadian lighting effects on health and wellbeing & Solar shading. **Trust Contribution** - £35k. **Other Contribution** - £45k. **Status** – In Progress
- 3 Resilience- Tackling overheating in urban dwellings. **Trust Contribution** - £40k. **Status** – Postponed until early 2018/19
- Optimum replacement of detectors. **Trust Contribution** - £12.5k. **Other Contribution** - £37.5k. **Status** – In Progress
- Lancaster Grange: Living Legacy. **Trust Contribution** - £15k. **Other Contribution** - £25k. **Status** – In progress

Demonstration & Dissemination

- BIM Case Studies. **Trust Contribution** - £24k. **Other Contribution** - £46k. **Status** – In Progress

Skills & Learning

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

Studentship

- Building Energy Environment: measurement, data, analysis & interpretation. **Trust Contribution** - £30k. **Status** – In progress
- Live BIM' - Real time Building Information Management. **Trust Contribution** - £30k. **Status** – Not approved - requires more in depth information before re-submitting to the Committee

Places

Demonstration & Dissemination

- Building Resilience to Natural Disasters. **Trust Contribution** - £12k. **Other Contribution** - £145k. **Status** – In progress

Studentship

- Digital Built Environment and Big Data. **Trust Contribution** - £30k. **Status** – Not approved - requires more in depth information before re-submitting to the Committee

Appendix B: Current Studentships

People (Health, productivity, safety and wellbeing)
Hybrid coupled modelling of heat and smoke movement through complex buildings, Ben Ralph, University of Edinburgh
Modelling indoor environmental quality in low energy housing, Maria del Carmen Bocanegra-Yanez, University of Strathclyde
Measuring and modelling overheating in domestic buildings, Kostas Mourkos, University of Loughborough
Places (community resilience, climate affects)
Social innovation systems for building resilient communities, Donagh Horgan, University of Strathclyde
Measuring the resilience of communities, Madeleine Edgeworth, Loughborough University
Holistic and semantic decision and policy-making model for resilient and sustainable urban infrastructures, Giulia Cerè, Cardiff University
Development strategies for future cities to ensure energy resilience, Ciaran Higgins (Part time), University of Strathclyde
Eco-cities – Towards energy positive districts enabled by BIM Level 3 Semantics, Corentin Kuster, Cardiff University
Future City Transport Strategy Development, Konstantina Bimpou, University of Strathclyde
Improving overheating risk assessment procedures in urban dwellings – Student TBC – Loughborough University
Property (efficiently and sustainably, resource efficiency, further proof, house quality)
District heating and cooling optimization and enhancement, Yu Li, Cardiff University
Low cost approach for characterization of Residential Building stock for energy labelling, Ioanna Vrachimi, University of Strathclyde
Bringing big data into building energy modelling - building energy focused geodemographic classification, Steven Zhang, Loughborough University
Dynamic energy analysis for the built environment, Valentina Bonetti, University of Strathclyde
Ignition of solid fuels exposed to transient incident heat fluxes, Simon Santamaria, University of Edinburgh
Embedding a circular economy in the building sector, Katherine Adams, Loughborough University
Traceability in the construction supply chain (productivity), Asselya Katenbayeva, Loughborough University
Flood resilience: Improving building drying times, Fiona Gleed, University of Bath
Real-time and semantic energy management across buildings in a district configuration, Jonathan Reynolds, Cardiff University
Smart Meter Data Analytics for Efficient Energy Management, Anthimos Ioannidis, University of Hertfordshire
Whole-Timber Structural Systems, Aurimas Bukauskas, University of Bath
Next generation natural fibre reinforced geopolymers, James Bradford, University of Bath
Optimising phase change material use for energy- efficient buildings, Ahmad Wadee, University of Bath
Biodiversity in community developments – Rosalie Callway – University of Reading
Automatic Generation of BIM Models by Semantisation of Building Data, an application in the energy retrofitting domain, Matthew Courtney, Cardiff University
Making the connection happen: A community regeneration framework for energy systems and low carbon solution – Maddelana Lovene – Strathclyde University
Building Energy and Environment: measurement, data, analysis and interpretation – Student TBC – Loughborough University
Blockchains for traceability assurance – Student TBC – Loughborough University

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BRE Trust

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