



# CIBSE JOURNAL



#Build2Perform

February 2019

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## Slow progress



This month is the 10th anniversary of the *CIBSE Journal*. To mark the occasion, we have gone back to the two people who appeared prominently in the first issue: TfL's environmental manager Quinten Babcock and industry sage Bill Bordass.

It's fair to say that both Babcock and Bordass have a reasonably pessimistic view of the last 10 years, and the progress the industry is making towards reducing the energy performance gap and contributing towards climate change targets.

Both lament that display energy certificates were never made mandatory by the government, and believe disclosure of building performance and an outcomes-

based approach to environmental targets needs to be adopted to force the industry to deliver what they design.

After 10 years of trying to encourage occupants to save energy by turning off PCs and lights, Babcock now believes that technical solutions should be used to shut down equipment automatically as people are fallible and have a tendency to forget.

Bordass is optimistic by the new sense of professionalism in the industry spearheaded by CIBSE, which requires engineers to promote sustainability. Bordass says this means understanding how your buildings perform – and the consequences of your action.

This is a year of anniversaries. CIBSE's academic journal *Building Services Engineering Research and Technology* celebrates its 40th birthday in 2019. The current editor Tim Dwyer has been looking at papers from its pre-digital predecessors. He was surprised by how much still resonates with engineering today. In the first of a series of articles on page 34, he draws attention to relevant papers on comfort, indoor air quality and building thermal assessment that tackle issues such as high PM2.5 levels in Edinburgh and occupant comfort in lightweight buildings.

In some areas, he found evidence that science had moved on, particularly in a paper on air quality, which stated that 'pollution by smoke from diesel vehicles is a very simple matter to deal with, as no smoke nuisance arises with a properly adjusted and well-maintained diesel.'

The annual Hays salary survey (page 63) is an indicator of how much building services engineer are in demand. Despite the uncertainty over Brexit, firms are optimistic about the year ahead and engineers are enjoying above-inflation pay rises. Those who want to get ahead in the industry should consider joining the CIBSE Young Engineers Network, which broadens both contacts and knowledge. Four regional leaders explain the benefits in our feature on page 67.

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**Hywel Davies**  
CIBSE's technical director rounds up the industry policy documents under consultation or being implemented



**Mike Hefford**  
Monthly carbon intensity calculations should be included in SAP, argues Remeha's general manager



**Julie Godefroy**  
CIBSE's technical manager looks at policy regarding MEEES and sustainable targets in planning



**Tim Dwyer**  
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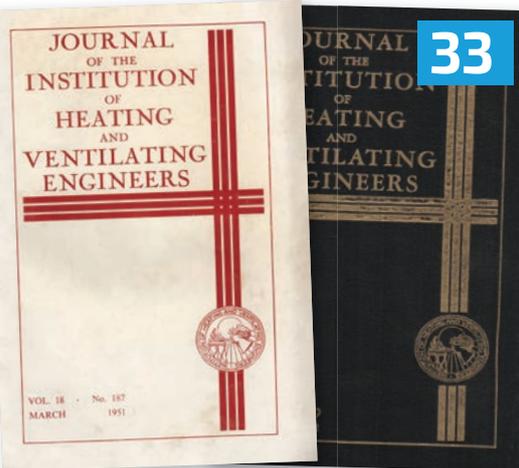
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## Electricity demand drops to 1990s levels

The amount of electricity generated in the UK last year was the lowest since 1994, despite the country's population growing by eight million since then, according to Carbon Brief. Its analysts used government and industry data to establish that generation was down by 1% in 2018 compared with 2017, and was 16% lower than its peak in 2005.

EU product standards have played a major role in reducing demand, the analysis showed. 'It could be a combination of more efficient appliances, energy-saving lightbulbs and, more recently, LEDs,' said Carbon Brief's policy editor Simon Evans. Supermarkets have also installed better fridges, while heavy industry is using more efficient pumps.

Renewables, which were responsible for just 6.7% of generation in 2009, accounted for a record 33% of electricity last year, according to Carbon Brief, up from 29% in 2017.

## Hitachi pulls plug on nuclear plant

Japanese industrial giant Hitachi has suspended work on the £20bn nuclear power station at Wylfa in north Wales.

The company said 'economic reality' had forced it to pull the plug on the project after talks with the British government about funding collapsed – despite Business and Energy Secretary Greg Clark saying it would take a one-third stake in the project. In addition, the UK government 'was willing to consider providing all of the required debt financing to complete construction'.

Wylfa was to be delivered through Hitachi's subsidiary Horizon Nuclear Power and the firm said it will reduce its presence on site, but 'keep the option to resume development in the future'.

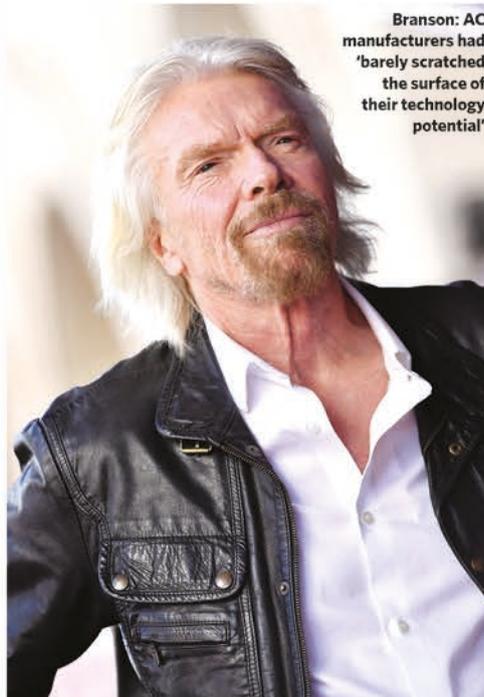
'We have made very strong progress on all aspects of the project's development,' said Horizon CEO Duncan Hawthorne.

## Branson brands air con efficiency 'pathetic'

**Global Cooling Prize promoted by entrepreneur aims to challenge 'entrenched' industry**

Virgin founder Sir Richard Branson has challenged the air conditioning industry to radically improve the performance of its equipment.

At the launch of the US\$3m (£2.33m) Global Cooling Prize, the entrepreneur said the industry had only achieved 14% of its 'theoretical' energy efficiency, which he said was 'pathetic'. He also accused manufacturers of being 'entrenched' and 'complacent'.



**Branson: AC manufacturers had 'barely scratched the surface of their technology potential'**

Air conditioning technology had not changed 'fundamentally' in 100 years, said Branson, and it was time to 'do things differently'. He added that AC manufacturers had 'barely scratched the surface of their technology potential'.

The prize fund has been set up by the US energy research body, the Rocky Mountain Institute, and is sponsored by the government of India.

It is designed to support the development of solutions that can cut the climate impact of residential air conditioning systems by 80%, at a cost of no more than double the current price of standard units.

This could prevent the release of 'up to 100 gigatons CO<sub>2</sub>-equivalent emissions by 2050' as demand for cooling soars, 'while enhancing living standards for people in developing countries', according to the Institute.

'As our planet warms, we need it [air conditioning] more than ever to keep our people cool,' Branson wrote in a blog.

'Worldwide, by 2030, extreme heat could lead to a US\$2tn (£1.5tn) loss in labour productivity. India's economy alone stands to lose US\$450bn – not to mention the 200 million Indians exposed to dangerous heat conditions each year.'

A report by the Rocky Mountain Institute said that the best cooling products had only reached 14% of their maximum theoretical efficiency compared to LEDs (67-89%) and photovoltaics (28-53%).

For more news on cooling see page 43 and view technical articles on cooling at [www.cibsejournal.com/cooling](http://www.cibsejournal.com/cooling)



## Addressing the UK's Energy Trilemma

Lars Fabricius - Managing Director

[www.sav-systems.com](http://www.sav-systems.com)



## GREEN LIGHT FOR SCOTLAND'S FIRST LARGE-SCALE WATER SOURCE HEAT PUMP



The Queens Quay regeneration scheme in Clydebank is the site for Scotland's first large-scale water source heat pump connected to a district heating network.

In the first stage of the £15m project, delivered by Vital Energi, two 2.5MW water source heat pumps will be installed.

These will extract heat from the River Clyde and use it to provide heating and hot water for the surrounding development. The heat generated at the energy centre will be pumped through 2.5km of district heating pipe connecting local homes, businesses and public buildings.

The £250m Queens Quay development includes the creation of 1,000 private homes and 200 properties for social rent.

## Modest growth possible for construction this year

**Office projects face slump, says CPA, but warehousing is booming**

Construction sectors could benefit from modest growth during 2019, according to forecasters – but only if the disruption from Brexit is contained.

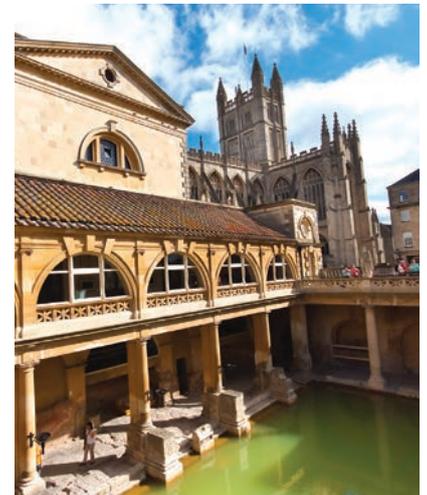
Accountancy firm KPMG forecasts that the UK economy will grow by 1.6% in 2019 and 1.7% in 2020, up from just 0.3% last year. This would aid recovery in the industrial and commercial construction sectors, according to the latest JLL/Glenigan UK Commercial Construction Activity Index. It showed that industrial starts were up 18% and office starts up 13.5% in the third quarter of last year, compared with the previous three months.

However, the Construction Products Association (CPA) has cut its prediction of output this year, to a rise of just 0.3%, with a recovery to 1.6% in 2020.

The CPA predicts a torrid year for office construction, which it believes will slump by 20% this year and remain flat in 2020. Infrastructure could rise almost 9% this year and 8% next, it says, but only if the government improves its record on delivering major projects.

Warehousing is going through a boom period thanks to soaring demand for storage and stockpiling facilities caused by fears of shortages sparked by Brexit. It grew by 20% in 2018, and is expected to rise by a further 10% in 2019 and 2020.

CPA economics director Noble Francis said its forecasts were conditional on the government getting a new Brexit deal or delaying Article 50. 'Even if this occurs, the uncertainty surrounding Brexit is clearly affecting construction in areas that require high investment up front for a long-term rate of return, such as commercial offices,' he said.



## Bath Abbey to be heated by Roman water

World famous Bath Abbey is replacing its Victorian heating system with one that uses hot water from the city's Roman baths.

Contractors are working to capture some of the 250,000 gallons of hot water that flow daily through the Roman baths from the thermal spring close to the Abbey and out into the River Avon.

The Abbey team believes this approach could produce 1.5MW of continuous energy to support a 200kW ground source heat pump system installed by renewable energy firm Isoenergy.

The plan is to install heat exchangers in the Abbey's structure as part of a wider £19.3m refurbishment project (see page 46).

## Government to make solar payment when FiTs closes in March

The government is consulting on a payment system for homes and businesses to replace the cancelled Feed-in-Tariffs (FiT) scheme.

Under the proposed plan, a 'smart export guarantee' will be introduced so owners of solar panels can be reimbursed for excess power they send to the Grid. However, the consultation only closes in March, when FiT is due to end, so there is likely to be a period when energy firms will receive this excess power for free.

According to energy minister Claire Perry, the new system will protect consumers from having to pay 'unfair costs'. 'This new scheme could help us build a bridge to the smart energy system of the future, with consumers firmly at its heart – not only buying electricity, but being guaranteed payments for excess electricity they can supply to the Grid.'

# Shelter says 3m social homes needed to address poverty

## Charity says economic benefits of investment will outweigh initial costs

Housing charity Shelter has called on the government to build more than three million new homes over the next 20 years, to meet soaring demand and address poverty and social-mobility issues.

In the wake of the Grenfell Tower fire, the charity set up a commission that included former Labour leader Ed Miliband MP, Baroness

Sayeeda Warsi, Baroness Doreen Lawrence, TV architect George Clarke and Grenfell survivor Ed Daffarn. It took evidence from social tenants, 31,000 members of the public and a range of housing experts, before publishing a report, *Building for our future: a vision for social housing*. This sets out a strategy for ensuring more people can access social housing.

The commissioners said politicians must not 'remain idle' when half of young people have no chance of buying a home, private renters on lower incomes spend an average of 67% of their earnings on rent, and almost 280,000 people in England are homeless.

The economic benefits of a major social housebuilding programme would outweigh the initial costs, according to analysis done for Shelter by Capital Economics. It would require an average yearly investment of £10.7bn during construction, but up to two-thirds of this could be recouped through housing benefit savings and increased tax revenue, the report said.



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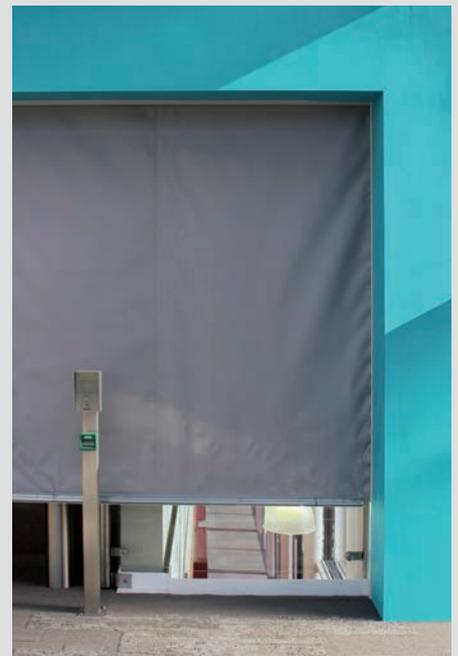
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## IN BRIEF

## Leti starts mapping out net-zero challenge

A technical guidance roadmap for developers is being drawn up by the London Energy Transformation Initiative (Leti). It aims to set out the approach and targets that developments must achieve to meet climate change targets.

Leti, an open network of professionals, said several workstreams are collaborating on the roadmap.

A net-zero group will develop the UK Green Building Council's definition for net-zero carbon into practical technical guidance, with examples for typical London typologies. The group will host a half-day workshop in March.

Meanwhile, the Part L methodologies group is developing recommendations on the role of energy modelling in the design process, both for compliance and for performance modelling.

For more on the workstreams, visit [www.leti.london](http://www.leti.london)

## New wiring regs now in force

The 18th Edition of the Wiring Regulations, also known as BS 7671, came into full effect on 1 January 2019. The changes were first introduced in July 2018.

Key changes include a revision of the requirements for surge protection devices (SPDs) and new requirements for arc fault detection devices (AFDDs).

In addition, the requirements for cabling support and fixings have changed, and more emphasis has been placed on protective devices being selected properly and working together in a system.

New rules also apply to work within special locations and there is a fresh appendix about energy efficiency.

## BSRIA Blue Book

BSRIA has published its 2019 'Blue Book', containing industry contact information, conversion data, key performance indicators, market statistics, legislation, and financial information.

The annual databook is 'small but concise' and offers 'a myriad' of guidelines and hard-to-find facts about building services.

## Clean Air Strategy places solid-fuel heating in its sights

### Sales of coal may be phased out and new targets set for wood-burning stoves

The government has promised to reduce harmful airborne particulates across 'much of the country' by 2030 and to meet targets set by the World Health Organization (WHO), as part of a new Clean Air Strategy.

It has set particular targets for wood-burning stoves in the plan to reduce overall emissions by 30% by 2020 and by 46% by 2030, adding that air pollution was one of the biggest threats to public health.

Secretary of State for Environment, Food and Rural Affairs Michael Gove said the strategy set more ambitious targets than were currently in force across the EU.

'Heating our homes with solid fuel makes a significant contribution to particulate matter; tiny particles that get into the lungs and blood

are transported around the body, becoming lodged in the heart, brain and other organs,' he said. 'Like many other pollutants, particulate matter can have a short-term impact over a single, highly polluted day, or long-term impacts from low-level exposure over a long period of time.'

Only the cleanest forms of biomass stoves will be available from 2022, and sales of bituminous or traditional house coal may be phased out as the government sets about halving the number of people living in areas with pollution above WHO guidelines by 2025.

The cost of air pollution could reach £18.6bn between now and 2035, according to government figures.

Gove claimed the Clean Air Strategy would reduce the cost to the NHS and society as a whole by £1.7bn a year from 2020, rising to £5.3bn a year from 2030.

## Manchester to design buildings with no 'operational carbon emissions'

All new buildings in Manchester will be net-zero carbon by 2028, according to the Greater Manchester Combined Authority (GMCA), as part of a strategy to make the city carbon neutral by 2038.

In its draft *Greater Manchester Plan for Homes, Jobs and the Environment*, the city sets out its plans to 'decouple emissions from economic growth' over the next two decades. Buildings will have to be designed to produce no 'operational carbon emissions', but the GMCA has yet to confirm whether the policy will also require carbon-neutral construction and supply chains.

'The need to decarbonise our economy means we must look at low carbon energy generation and storage, retrofitting of buildings, and low carbon transport,' said Greater Manchester Mayor Andy Burnham.

'Future climate change pressures will also require the city region to adapt to bigger shocks and stresses – such as increased heat, drought and flood risk – which may require new sources of funding.'



## UK'S FIRST BATTERY-POWERED HOTEL UP AND RUNNING

The Premier Inn at The Gyle, Edinburgh Park, has become the UK's first battery-powered hotel in a bid to improve energy efficiency and security. It also aims to reduce running costs by up to £20,000 a year.

The Premier Inn is trialling a new 100kW lithium ion battery at the 200-room site. It is 3m<sup>3</sup> and weighs approximately five tonnes, and draws power from the National Grid during off-peak periods.

The battery, installed by E.ON, has the capacity to run the hotel for up to three hours and takes two hours to fully charge. It will be used for at least two to three hours per day, depending on the needs of the National Grid.

The Gyle was chosen as the first site to trial the battery partly because Scotland is a large producer of renewable power, which can be prone to volatility – so the battery will provide valuable back-up.



## ASHRAE aiming for net-zero energy HQ

A US\$15.7m renovation of ASHRAE's new headquarters building in Atlanta, Georgia, aims to create a net-zero energy facility.

The site, 10 miles north of the society's current headquarters, was chosen to demonstrate how a 1970s building can be transformed to give 'modern, high performance'.

ASHRAE will work to reduce energy consumption to below 22 kbtu/ft<sup>2</sup> year, with a limit of maximum daytime plug load to 0.5 W/ft<sup>2</sup>, so that its building can be a model 'for reducing the carbon and environmental impacts of business operations in a cost-effective and replicable way'.

## Death prompts review

An infection linked with pigeon droppings has been identified as a 'contributing factor' in the death of a child patient at Queen Elizabeth Hospital Glasgow in December.

Scottish health secretary Jeane Freeman said that a review was taking place into the design, build and maintenance of the £842m hospital, which opened in 2015.

The likely source of the infection has been traced to a 12th-floor room containing machinery that is not open to the public. Small traces of pigeon excrement were discovered in the room, which had a small break in the wall – though it is unclear how the bacteria entered the ventilation system.

As part of the hospital's additional infection control measures, portable HEPA air filter units have been installed in specific areas as a precaution.

# Parliament debates adoption of project bank accounts

**New Bill aims to ensure small businesses are paid 'directly and promptly'**

A new Bill calling for payments on government and public authority contracts to be made through a 'project bank account' was put before Parliament last month.

The Public Sector Supply Chains (Project Bank Accounts) Bill, backed by the Specialist Engineering Contractors' (SEC) Group, was proposed by Debbie Abrahams MP to help ensure small businesses are paid 'directly and promptly'.

It will also protect them from the kind of losses sustained by supply chain firms after the collapse of Carillion.

'Late payment by large businesses is a massive issue across all business sectors, leading to billions of pounds being owed to smaller companies for work that has been done,' said Abrahams.

'When payments take a long time working

their way along a supply chain from the contracting authority, there is a risk that the cash could be cut off at any time because of payer insolvency.

'My Bill aims to set in law the requirement that parties delivering government and public authority work – from the lead contractor right down through the supply chain – will receive payment from the same secure pot of money.'

Carillion collapsed in January 2018 owing more than £2bn to smaller suppliers, which created a 'catastrophic effect' that must be avoided in the future, Parliament was told.

Abrahams added that the 'precarious position' of other large construction firms meant the government should take 'urgent action'.

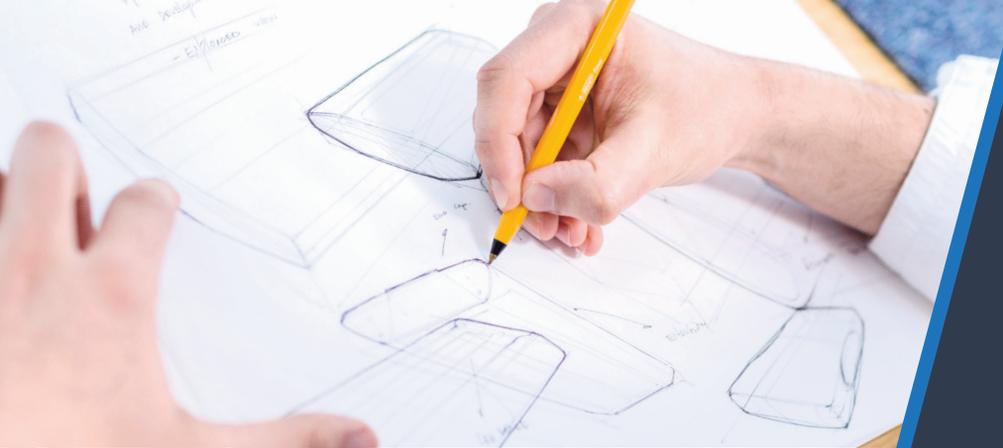
SEC Group chief executive Rudi Klein said project bank accounts were 'acknowledged to be the most effective method of ensuring secure and regular cash flow'.

## Unite union demands Carillion prosecutions

A year after the collapse of Carillion, the trade union Unite has accused the government of risking another 'corporate meltdown' by failing to take legal action against any of the company's directors or senior managers. It has also criticised the pension regulator for not delivering any recommendations from its investigation into the £800m shortfall in the firm's pension fund.

Unite assistant general secretary Gail Cartmail said: 'The government's failure to take action to ensure there cannot be similar collapses in the future is a betrayal of workers, who still face being cast on the scrapheap without warning because of irresponsible directors who place profits and shareholder dividends before people. The fact that no-one involved in Carillion has yet had any form of action taken against them demonstrates either that the regulators are failing to do their jobs or that existing laws are too weak.'

Carillion was forced into liquidation on 15 January last year with a reported £7bn of liabilities and just £29m in the bank. It has been suggested that the company had been trading while insolvent for some time before going under holding more than £2bn of unpaid invoices to small suppliers.



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## Call for entries: SLL Ready Steady Light

Entries are now being sought for the 2019 Ready Steady Light competition, which takes place on 26 March.

The event is held in partnership with – and hosted by – Rose Bruford College, in Sidcup, Kent.

Teams compete to design and set up temporary exterior installations, with a limited range of equipment, in three hours.

The competition is always popular, so entry is restricted to one team – of up to five people – per organisation, with first-timers particularly encouraged to enter. Each team must be led by an SLL member.

Entry, which costs £150, closes on 18 March and prizes will be awarded in three categories.

To register your interest in entering a team for this event, email [sll@cibse.org](mailto:sll@cibse.org)

## CIBSE publishes first Well Building guide

### Inaugural section of *Working with Well* document focuses on air

CIBSE's newest digital tool aims to help engineers and project teams position the Well Building tool in a UK context.

Each of the Well requirements is mapped against World Health Organization guidelines, and CIBSE and SLL guidance,



British and European Standards, and Breeam, among others.

Increasingly, engineers may be asked to respond to the Well Building Standard, either by meeting its requirements in full for project certification or by benchmarking some aspects of their scheme against it.

The Well Building Standard originated in the US, so a number of its requirements refer to US codes and standards that may not be clear or relevant in a UK context.

This tool refers to Well v1 and focuses on offices. Well pilots and features applicable in other environments (for instance, commercial kitchens) are not covered here.

This first section – Air – was published in early January; four other sections – water, light, comfort and mind – will follow in due course.

This tool is available on the CIBSE Knowledge Portal at [www.cibse.org/knowledge](http://www.cibse.org/knowledge)

## Nominations for officers, Board and Council members

New CIBSE officers, Board members and Council members take office each year from the AGM in May. Officers and Board members serve on the Board, which is CIBSE's governing body. It comprises the seven officers (President, president elect, three vice-presidents, honorary treasurer and immediate past president) and five Board members.

Changes to the by-laws and regulations governing officer and Board member elections were approved at an EGM in May 2018, and Privy Council assent was subsequently received. Under the new arrangements, all candidates for officer and Board member vacancies arising at the AGM must be considered by the Institution's Nominations Panel, to which all sections of the Institution are invited to suggest candidates. The panel seeks to reflect Charity Commission guidance by nominating a range of candidates with the skills and experience to fulfil the Board's role as the governing body of a registered charity. It also seeks to ensure a balance of representation from different sectors of the industry.

Having considered the advice of the panel, the Board nominates candidates for president elect and Board member vacancies. Any eligible candidates proposed by the Nominations Panel but not nominated by the Board may also put their names up for election; on this occasion, however, no such candidates were put forward.

### The Board's nominations this year are as follows:

#### President elect:

**Stuart MacPherson CEng FCIBSE**

#### Members of the Board:

**Les Copeland FCIBSE**

**Fiona Cousins CEng FCIBSE**

**David Fitzpatrick**

The Board, having considered the advice of the Nominations Panel, also appoints three vice-presidents and the honorary treasurer to take office at the next AGM. These appointments are normally made from those who serve, or have served, on the Board, and all those listed below are current officers or Board members. The Board's appointments to take office in these roles from the 2019 AGM are:

#### Vice-presidents:

**Ashley Bateson CEng FCIBSE**

**Kevin Kelly CEng FCIBSE FSLL**

**Kevin Mitchell CEng FCIBSE**

#### Honorary treasurer:

**Adrian Catchpole CEng FCIBSE**

The Council is a larger consultative body, which advises the Board on Institution policy. It includes representatives of Regions, Societies, Groups, Networks and Standing Committees, and elected members, who serve a three-year term. The Board has agreed to operate a similar procedure for election as that which applies to Board members, and two corporate and one non-corporate positions are available for election each year. The Board, having considered the advice of the Nominations Panel, agreed to nominate the following individuals. There were no candidates suggested for consideration by the Panel but not nominated by the Board, so the following candidates will be declared elected at the AGM in May 2019:

#### Members of Council:

**Sebastian Gray (Non-corporate)**

**Andrew Piper CEng MCIBSE (Corporate)**

**Linda Vidler CEng MCIBSE (Corporate)**

Further details on the nominations process, qualifying criteria and biographical notes can be found in the members' section at [www.cibse.org](http://www.cibse.org)

## Cyber security guidance in Digital Engineering Series

CIBSE has just published DE6.1: *Cyber security in building services design* to help those who commission, design, construct and operate built assets to understand the implications of security on building services design.

The implications for security may be national, commercial or private security, each of which have their own requirements.

DE6.1 considers the risks and threats around security, and examines these in the context of building services design. It looks at how such considerations should change the approach to design, and identifies the need for dedicated security experts to feed into the process.

As buildings' internal systems become increasingly 'smart' and connected, they also become more vulnerable to cyber attack. This new publication will give readers an understanding of how to carry out a basic risk assessment and help them to know when to seek expert assistance.

All the current publications in the Digital Engineering Series, plus the six digital engineering online learning modules, are available at [www.cibse.org/des](http://www.cibse.org/des)

**Maggie's Barts won the innovation award**

## CIBSE Membership application workshop heads to Bristol

Looking to upgrade to ACIBSE or MCIBSE in 2019? Our engaging CIBSE interviewers will help you get to grips with: the application criteria; starting your report; what you need to submit; and preparing for your CIBSE interview.

The half-day workshop is interactive and you will start writing your evidence during the session. Our experienced CIBSE interviewers will also share their top tips with you.

Everything is conducted in a positive atmosphere, to help you start on the right track.

The next session is in Bristol on 8 February. Book your place today at [www.cibse.org/workshop](http://www.cibse.org/workshop)



# Arup and BuroHappold win at Façade of the Year

**Annual competition showcases excellence in design and engineering**

Three striking buildings have been recognised at the Society of Façade Engineering (SFE) Façade of the Year Competition 2018.

Arup Façade Engineering and Sir Robert McAlpine won the Innovation award for Maggie's Barts. The Refurbishment award was won by Arup Façade Engineering for the University of Leicester's Engineering Building, while BuroHappold Façade Engineering took the New Build award for the Louvre Abu Dhabi.

The SFE Façade of the Year Competition, now in its sixth year, is the façade industry's longest-running and most prestigious awards. It recognises and rewards excellence and achievements in the field of façade engineering, and draws attention to the importance of façades in modern architecture.

This year's judges said that each of the

winners had succeeded in achieving façades that are diverse but equally remarkable.

It is more important than ever, they added, to celebrate the achievements of the award-winning entries and their contribution to façade engineering.

The winners were announced in December at the Glass Supper.

Read more about the Louvre Abu Dhabi in the February 2018 edition of *CIBSE Journal* [www.cibsejournal.com](http://www.cibsejournal.com)



**The University of Leicester's Engineering Building**

**The Louvre Abu Dhabi**



# Taking stock

As *CIBSE Journal* enters its 11th year, an unprecedented level of activity in legislation and policy is affecting building services engineers in the UK and worldwide. Hywel Davies looks at what is happening

Everybody welcomes certainty – but there is not a lot of it about. And that is nothing to do with the UK's future relationship with Europe. Last year, CIBSE responded to 29 consultations and Select Committee enquiries, as well as engaging with the Independent Review of Building Regulations and Fire Safety.

A great deal of policy activity in areas relevant to CIBSE members is also under way at the moment, as we move from consultation and debate to implementation on several fronts.

While some of it is specific to England, or even to London, much has wider relevance. Many of the issues are relevant to the devolved administrations, while fire safety, reducing carbon emissions, 'zero carbon' buildings and indoor air quality have global resonance.

In England, several parts of the Building Regulations are under review. The Implementation Plan<sup>1</sup> issued in December, in response to the Independent Review, committed government to a full technical review of Part B. It proposes possible changes on a number of technical issues, going well beyond the activity to clarify the current Guidance that has been under way for some time.

This process has already started, with a call for evidence<sup>2</sup> published in December alongside the Implementation Plan. This is in addition to the changes to Regulation 7, banning combustible materials from external walls of residential buildings more than 18m high, introduced in December.<sup>3</sup>

The Society of Façade Engineering<sup>4</sup> is already busy developing guidance for its members on the detailed implications of the new rules, but it is clear that the design of façades for high-rise residential buildings will have to change.

Also in the response to the Independent Review is a commitment to update Parts L and F (governing energy use and ventilation respectively). The same paragraph<sup>5</sup> commits to a review of Part M (access) to complement work already being done in the wake of a report<sup>6</sup> from the Equalities Select Committee on the issue of accessible toilets. It also talks of a workplan for dealing with other technical requirements, such as Part P (electrical safety), 'in the new year'.



**"We need a move towards regulation of real carbon emissions in use, with incentives for those willing to lead the way"**

We will not be short of things to do on Building Regulations.

The review of Parts L and F will also address overheating risk. CIBSE has some clear goals for the review: we need a clear trajectory for improving Building Regulations over time so that all new buildings achieve net-zero carbon by 2030, with milestones for interim stages.

The next edition of Part L must drive significant further improvement in the target carbon dioxide emission rate. Beyond that, we need to see a move towards regulation of real carbon emissions in use, with genuine incentives for those who are willing to lead the way in measuring and reporting this.

What would Part L compliance based on actual performance – rather than design intentions, sometimes unfulfilled – look like? This approach would also be more in line with the greater emphasis on whole-life performance of buildings set out in *Building a Safer Future*.

To help drive innovation and investment, we should allow local authorities to set requirements that are more challenging than the Building Regulations, while remaining realistic.

In relation to Part F, we would like to see a focus on achieving indoor air quality and not just ventilation rates.

There are advantages to performance or outcome-based regulations, but they need to define the appropriate outcomes. For too long we have focused on air movement at the expense of air quality.

It is not just Building Regulations that are addressing the quest for clean air; it has been a significant concern in London for some time, especially in relation to particulates from diesel engines.

The Clean Air Strategy, published in January, acknowledges the need to address many of the concerns that CIBSE raised in the consultation last year, but ducks the call to adopt World Health Organization (WHO) limits on pollutant levels. If we don't listen to the WHO, then who do we listen to? For more on this topic, see page 16.

It is unfortunate that, with heightened awareness of pollution in city centres, schools and offices, we still ignore the problems of pollutants in industrial workplaces. Occupational lung disease is one of three



The government has made a commitment to update Part L – the energy regulation

priority areas for improving workplace health. In the UK, around 8,000 people each year develop chronic health problems from exposure to dusts and vapours in the workplace, in spite of health and safety legislation requiring employers to control exposure to pollutants.

The Institute of Local Exhaust Ventilation Engineers (ILEVE<sup>7</sup>), the CIBSE Division focused on this specialism, works closely with the HSE and wider industry through the LEV Forum to increase awareness of – and compliance with – the relevant legislation, including the recent classification of welding fumes as carcinogenic. All CIBSE members should be aware of the specialist requirements and available expertise in this area of work.

Finally for this round-up, there is the ongoing development of electric vehicles and the need to deliver the infrastructure to support them.

This will have implications for building services, with additional electrical demands needing to be serviced in and around buildings and supported by the distribution network. We can expect a lot more activity in this area and it will involve several government departments.

Cross-departmental coordination always adds to the excitement of emerging policy, so this promises to keep us engaged for a little while longer. In the meantime, there is a significant opportunity for CIBSE members to help shape the built environment in which we live and move for many years to come.

#### References:

- 1 Ministry of Housing, Communities and Local Government (MHCLG), *Building a safer future: an implementation plan*, 18 December 2018 – [bit.ly/2HuIYZW](http://bit.ly/2HuIYZW)
- 2 MHCLG, *Technical Review of Approved Document B of the building regulations: a call for evidence*, 18 December 2018 – [bit.ly/2HuK2Nq](http://bit.ly/2HuK2Nq)
- 3 MHCLG, Building (Amendment) Regulations 2018: Circular 02/2018 – [bit.ly/2FWwk3s](http://bit.ly/2FWwk3s)
- 4 [www.cibse.org/society-of-facade-engineering-sfe](http://www.cibse.org/society-of-facade-engineering-sfe)
- 5 MHCLG, *Independent Review of Building Regulations and Fire Safety*, 17 May 2018, Paragraph 2.36 – [bit.ly/2KKbzXV](http://bit.ly/2KKbzXV)
- 6 Women and Equalities Committee, *Building for equality: disability and the built environment*, ninth report of session 2016/17, 25 April 2017, page 39 onwards – [bit.ly/2FKkVVh](http://bit.ly/2FKkVVh)
- 7 [www.cibse.org/institute-of-local-exhaust-ventilation-engineers-i](http://www.cibse.org/institute-of-local-exhaust-ventilation-engineers-i)

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# Missing opportunities

Last year was a very busy one for government statements of intent, but what has actually been confirmed – and what can we expect in 2019?

Julie Godefroy rounds up the latest policy developments

The government has made numerous announcements in the past two years about its intended direction on energy, carbon and the environment. Many of these have been framed by the Clean Growth Strategy and by Theresa May's Grand Challenge to 'at least halve the energy usage of new buildings by 2030', and 'halve the costs of reaching the standard in existing buildings'.

There are some glaring omissions in the Clean Growth Strategy: it is silent on fracking, the expansion of Heathrow, and the government's moratorium on onshore wind in England, even though all of these are important parts of the national infrastructure and environmental landscape, with potentially significant negative impacts.

There is, however, a lot that CIBSE welcomes and which is aligned with advice from the National Infrastructure Commission and the Committee on Climate Change, including: the very existence of a strategy, which can help long-term decisions, innovation and investment; the continued commitment to carbon reductions; and the attention to energy efficiency and retrofit.

Unfortunately, more than a year later, there has been little progress. Some delay is understandable when the Ministry of Housing, Communities and Local Government is working on regulatory reform in response to the Grenfell tragedy, and government is grappling with Brexit. However, there were stark reminders last year of the urgent need to reduce carbon emissions dramatically ('Time to act', *CIBSE Journal*, November 2018). CIBSE highlighted concerns in response to the recent parliamentary inquiry on energy efficiency, and here are some examples.

## MEES

The first implementation phase of the minimum energy efficiency standards (MEES) came into force last year, requiring private rented properties to have an Energy Performance Certificate (EPC) rating of E or above. Unfortunately, government has ruled that residential landlords need not spend more than £3,500 to achieve this, even if this may result in tackling only about half of the F- and G-rated properties. It's difficult to reconcile



**"We need to see leadership from public building occupiers. It is a very poor signal that the NAO occupies a building with a G-rated DEC"**

this with the government's ambition for fuel poverty to be reduced and for most homes to be EPC-C by 2030.

Retrofitting existing building stock is particularly challenging, and we need to maximise opportunities from 'trigger points', such as sales, new leases, and works requiring building regulations and/or planning approval. MEES should ensure that as many properties as possible are upgraded. There should also be a clear trajectory of progressive tightening, so that landlords who wish to be encouraged to go further than the minimum E rating, thereby reducing their need for further expensive and disruptive works in the future.

## EPCs and DECs

The register of EPCs and Display Energy Certificates (DECs) for public buildings is still an under-used resource, because its publicly available data is often of poor quality and not regularly updated. As a result, it does not raise public awareness. Nor does it act as a driver for occupiers of public buildings, or help professionals analyse building performance data to turn it into useful information, such as benchmarks or trends in the best buildings. Improving the quality and functionality of the register is a low-cost measure that would be of significant value

to industry, government and academia.

In parallel, we need to see leadership by public building occupiers, demonstrating a responsible use of energy resources and of our money. It is a very poor signal, for example, that the National Audit Office occupies a building with a G-rated DEC.

## Sustainable targets in planning

Finally, years after the 2015 Housing Standards Review – and despite the Localism Act – there is still great uncertainty and confusion about whether local authorities (except the Greater London Authority, which has greater powers) can set energy, carbon and sustainability targets beyond national standards in their planning requirements. We understand that improvements over Part L equivalent to the (now defunct) Code for Sustainable Homes Level 4 are allowed, but government has not confirmed this widely

**JULIE GODEFROY**  
is technical manager  
at CIBSE

or unambiguously. Even this constrains local authorities who wish and are able to require higher standards towards zero carbon – and it does not cover other sustainability issues, such as green infrastructure. This really should be sorted as soon as possible, to let local authorities show leadership.

### Building Regulations Part L and F

As mentioned in previous columns, CIBSE has produced a position paper with recommendations for changes to Building Regulations Part L and F, covering energy, carbon, air quality and overheating ([bit.ly/CJFeb19JG](http://bit.ly/CJFeb19JG)). Since then, government has confirmed that the upcoming review will indeed cover overheating and air quality, as well as energy and carbon. We very much welcome this, and government is expected to consult later this year.

### Environmental Regulations

The Department for Environment, Food and Rural Affairs has published a number of important documents in recent weeks:

- **Clean Air Strategy:** The revised document still fails to propose air-quality objectives aligned with the World Health Organization, as we recommended. However, it shows significant improvements in acknowledging the need for more attention to indoor air quality and to prevention through the planning system, both of which we have advocated.
- **The Environment Bill** sets the framework for environmental regulations and enforcement post-Brexit, and it proposes to enshrine the 25-year Environment Plan in statute. It also comes with a draft monitoring framework of environmental indicators. This is encouraging, and we will give a more detailed update in next month's *Journal*.
- **Monitoring framework for the 25-year Environment Plan:** While we haven't looked at the detail yet, the creation of indicators to monitor and report on environmental conditions is very encouraging in itself.

We will comment on these in next month's *Journal*.

### Current consultations

- **Heat Networks – Code of Practice for the UK.** Revised edition. Closing date for responses is 10 February.
- **Decarbonising heating:** Overview of current evidence. Closing date for contributions to a CIBSE response is 12 February.

- All the consultations with which we engage can be found at [cibse.org/news-and-policy/consultations](http://cibse.org/news-and-policy/consultations)

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# GLOBAL REACH

New BIM standards are being published, which are based on existing UK standards and documents. CIBSE's **Carl Collins** considers the key changes

**I**n my article back in February last year, I spoke about the new international standards that were being developed for BIM, based on our existing standards and PAS documents under the '1192' series.

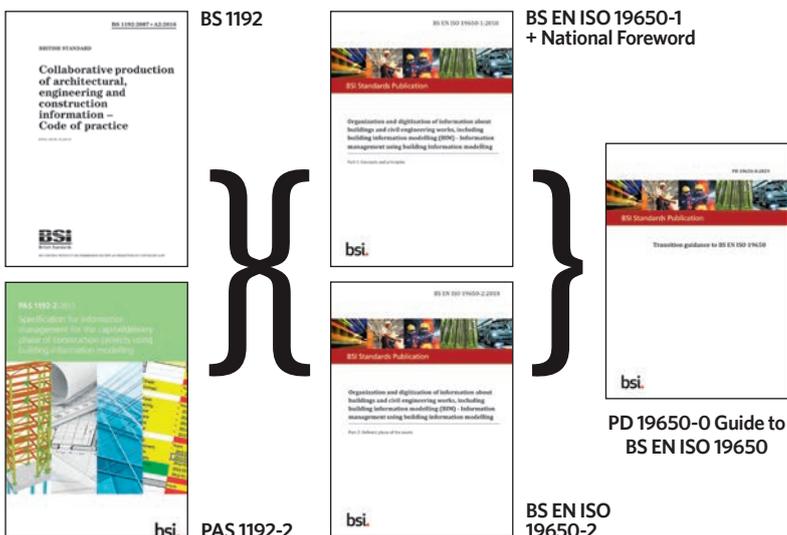
The first of these standards has now been published and the corresponding '1192' ones withdrawn; what does this mean for construction professionals?

This is the initial release of international standards that will be replacing our national ones over the next few years, and there are three documents you should be aware of. They are BS EN ISO 19650 Part 1, BS EN ISO 19650 Part 2 and PD 19650-0. The first two are the actual standards, complete with European and national forewords and annex; this is what makes them applicable to the UK market. However, it is the main body of the text that makes them widely applicable.

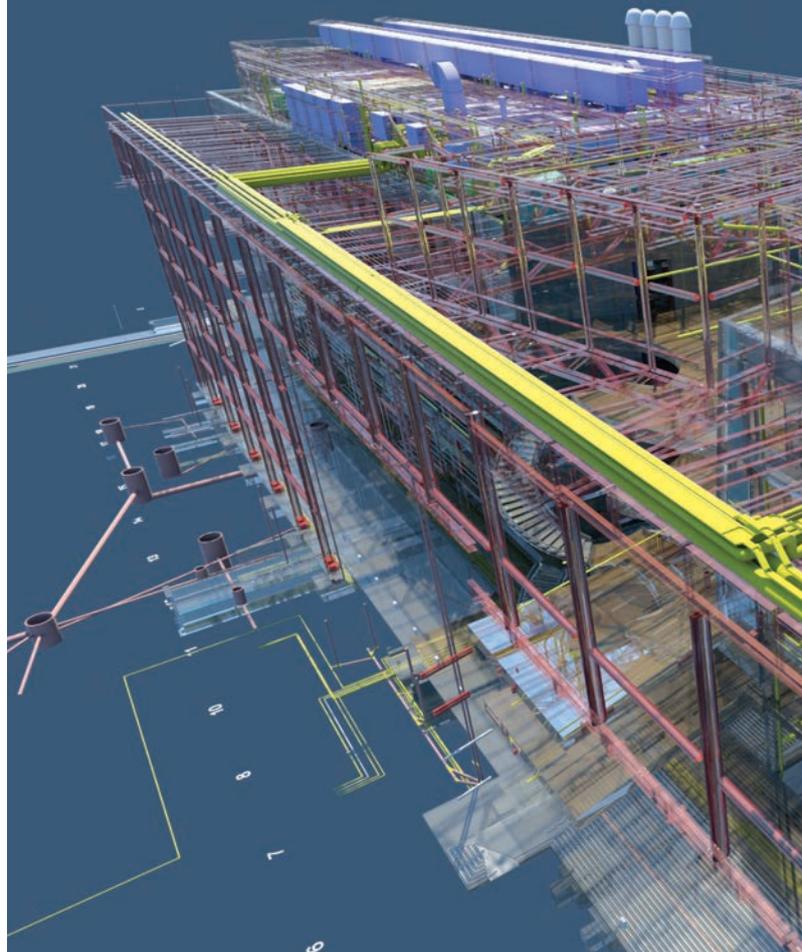
The published document (PD) is guidance on the transition from our tried and trusted '1192' documents and the new 19650 standards. In short, there is actually not a huge amount of change, but some terminology has altered and it is worth talking a bit about that here.

Also, the flow of the standards is different from that which we had before. The withdrawn BS 1192:2007 and PAS 1192-2 built on one another, while the ISO standards have a different delineation between them. The first part is about concepts and principles, while the second is about the actual delivery of BIM on projects.

There will also be a more general guide to the 19650 series of



Changes to the flow of BIM standards: BS 1192 and PAS1192-2 have been superseded



**“Probably the most noticeable change is that we no longer refer to ‘BIM Level 2’, but now ‘BIM according to ISO 19650’”**

standards produced by the British Standards Institution, which should be available in the next month or so. This will be an ongoing guide to the use of the standards, unlike PD 19650-0, which is purely about how you transition to the new standards.

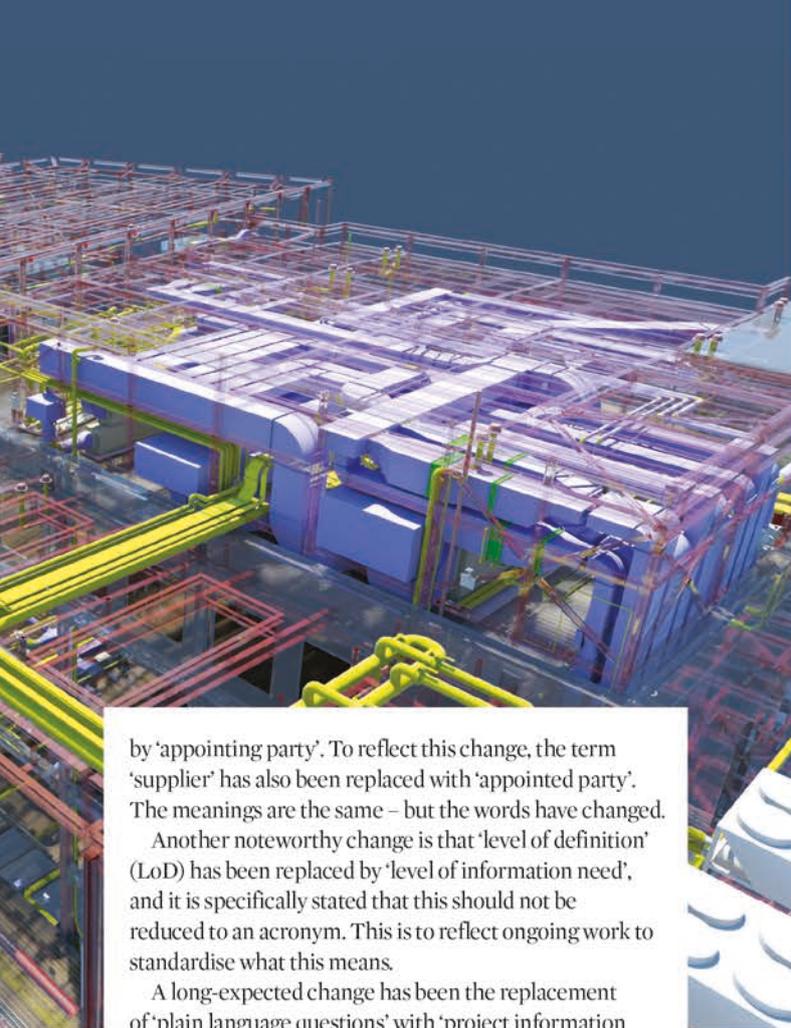
Some of the terms we have become accustomed to over the past few years have been changed to allow them to be translated into other languages more easily and accurately. It is worth looking at a few of them here.

## The changes

Probably the most noticeable change is that we no longer refer to ‘BIM Level 2’, but now ‘BIM according to ISO 19650’. This is a good change; we dropped the ‘BIM Level 3’ concept in favour of ‘Digital Built Britain’ some time ago, so the ‘Level 2’ part was always a bit misleading.

Another change is that from ‘employer’s information requirements’ to ‘exchange information requirements’. The abbreviation EIR remains the same and the purpose also stays – to specify what information an employer requires from a project team. The reason for the change is that the term ‘employer’ does not retain the intended meaning when translated into some languages.

As a result, the term ‘employer’ has been removed from the rest of the standard and has been replaced



by 'appointing party'. To reflect this change, the term 'supplier' has also been replaced with 'appointed party'. The meanings are the same – but the words have changed.

Another noteworthy change is that 'level of definition' (LoD) has been replaced by 'level of information need', and it is specifically stated that this should not be reduced to an acronym. This is to reflect ongoing work to standardise what this means.

A long-expected change has been the replacement of 'plain language questions' with 'project information requirements'. Again, the purpose remains the same.

Other items of note are that the field codes for file naming have been updated to better reflect actual practice on real projects. The order and names of the fields remain exactly the same, but the lengths of the fields have been altered to suit real-world conditions.

The 'project' and 'originator' fields remain the same, with two to six characters for the project, and three to six characters for the originator. The volume/system field has been standardised on two characters, which will help provide consistency across projects.

Level/location is still a bit tricky, as it still has some standard fields such as B1 for Basement 1, but it also calls on BS EN ISO 4157-1 and 2 for floor notation, which conflicts with the recommended standard fields. We would suggest that floor level naming be resolved in the BIM kick-off meeting and quoted in the BIM execution plan, so the whole project team know what to use and how to use it.

The 'type' field remains as before, but the 'role' field may now use one or two characters, which should help, as the original single character field was always problematic.

Finally, the 'number' field has been expanded to six digits, which is a welcome change, and the requirement for the numbers to be sequential has gone; series numbers now can be used (as building services engineers have done for some time now) to help differentiate files, and to order them better. For example, the number field can now be used to differentiate between electrical services drawings, based on the content of that drawing, so we could have a number of 62001 for a small power drawing and 63001 for a lighting drawing in the same area.

Hopefully these changes will be welcomed. The skills gained by using the original British standards will now become skills that can be exported around the world. 



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# CHALLENGING TEN YEARS

The first issue of *CIBSE Journal* – published 10 years ago this month – featured two sustainability champions who are still active today. **David Blackman** speaks to Bill Bordass and Quinten Babcock about the past decade and what still needs to be done to meet environmental targets



## Quinten Babcock

There have been some big changes in the operational environment at TfL since 2009. The capital's transport agency is facing a massive shortfall in funding thanks to the withdrawal of government support for operating costs – a cut that has been compounded by London Mayor Sadiq Khan's commitment not to raise fares.

At the same time, the energy efficiency policy framework in London has become more demanding. While, a decade ago, the Greater London Authority was seeking a 60% reduction in emissions by 2025, Khan wants to make the capital zero carbon by 2050.

'We have to get leaner. We need to reduce costs rapidly and improve energy efficiency with the drive to zero carbon for London,' says Babcock, who has spent a big chunk of his time over the past decade fixing Palestra, TfL's flagship main building on London's South Bank. The work has saved £426,000 on energy bills in 12 months thanks to a 17% improvement in energy efficiency.

What Babcock describes as the 'ridiculous' level of out-of-hours electricity consumption at TfL seems to be as big a headache for him now as it was when he was interviewed in 2009. 'Half of the electricity supply is consumed after 6pm on weekdays and at weekends,' he says. 'We have some out of hours, but lots of people work Monday to Friday, and a lot of kit is left on.'

Ten years ago, Babcock was putting his faith in getting employees to change behaviour, but this has proved to be a 'massive challenge'. 'If there is a technical solution,' he says, 'we should grab it, as it will be more consistent – because people forget.' The 43-year old is now working with TfL's IT teams to automate PC shutdowns out of hours, and with its FM provider to improve use of its HVAC.

On the broader sustainability front, Babcock describes the progress made over the past 10 years as 'uncertain'. 'Ten years down the line and the planet is looking even worse,' he says.

There have been some bright spots, though. Energy Performance Contracts (EnPCs) – which were only being trialled in 2009 – are starting to work. However, Whitehall support for Design for Performance (DfP), which ties developers to actual targets, has been terrible, he says.

Babcock describes central government as the 'pantomime villain' of building sustainability, recalling its 11th-hour move to stop display energy certificates (DECs) becoming mandatory for private buildings, even though this was the case in the public sector. While non-domestic building Energy Performance Certificate (EPC) ratings may be necessary, they are 'not sufficient' to determine operational energy use. >>

**T**he latest social media sensation is the #10YearChallenge, for which celebrities post 'compare and contrast' images from a decade ago and now.

To mark the 10th anniversary of its relaunch issue, *CIBSE Journal* has gone back to two prominent industry figures who featured in that 2009 edition.

On the cover was Transport for London's (TfL's) environmental manager Quinten Babcock, who had just been named CIBSE Champion of Carbon Saving Champions. Inside, Bill Bordass, research and policy adviser for the Usable Buildings Trust, wrote about why buildings in 2009 were failing to meet designers' goals or users' expectations.

Ten years on, we wanted to know whether Bordass was more optimistic and whether Babcock still had a champion's thirst for delivering sustainable buildings. What have they been up to over the past decade, how far have we progressed on sustainability, and what key lessons have they learned in the intervening years.

» The industry, however, must take some responsibility for the lack of progress, says Babcock, who identifies two chief problems: the construction design and build process, and a 'lack of competence' in the facilities maintenance industry.

So how will the industry achieve its climate targets? Babcock argues for implementing DfP for new builds; motivating the construction and FM industry to achieve better operational energy performance; making EnPCs mandatory for retrofits – and perhaps even for all FM contracts; and requiring the energy usage of all buildings – or, at the very least, those in the non-domestic sector – to be disclosed.

Enforcing DEC's for non-domestic buildings – together with some form of mandatory disclosure – could be the mechanism to get the wider industry to take sustainability seriously. 'There must be a way of getting FMs to buy into operational energy, at least from a HVAC perspective,' says Babcock. 'We need to motivate the industry – get people to care.'

**Bill Bordass**

If he had been told 10 years ago how little progress would be made on tackling climate change, the building scientist Bill Bordass would have been 'completely shocked'. The 2009 Copenhagen UN climate change summit – expected to be a breakthrough – was, in Bordass's words, 'a fiasco'. It took until Paris 2015 for substantial progress to be made. At the recent follow-up event in Poland, there was more appreciation that urgent action is required: 'People are realising it is the last-chance saloon: if we don't get a grip on things well before 2030, it will be far too late.'

In his 2009 article, Bordass said the UK government was 'committed' to improving the sustainability of new and existing buildings, but wasn't going about it effectively: 'too much rhetoric and not enough action'.

After 10 years, his 'big disappointment' is faltering progress on DEC's, with government support 'completely hopeless'. Bordass had been part of a team that had worked hard between 2000 and 2008 to 'make in-use performance visible and actionable' by helping to get DEC's established in the UK and the EU. He also working with CIBSE to develop the TM47 process and benchmarking system – designed to evolve rapidly with feedback, but completely neglected since publication, because DCLG did not make its database an open, public asset, but outsourced it.

Bordass was also on the UKGBC's working party that advocated DEC's for offices, helping to get them into the draft 2011 Energy Bill. He recalls: 'We got lots of people on side, including the CBI. However, at the last

minute, the government axed this requirement.'

Bordass believes privatisation and outsourcing has led to a 'terrible loss of institutional and collective memory' in Whitehall. 'It makes it difficult to make joined-up decisions; there is no scientific civil service, so policy-making is influenced by external pressures from vested interests and well-meaning but blinkered single-issue lobbyists,' says the former RMJM building services leader. He likens the government to a drunk looking for a set of lost keys at night. 'He searches under the lamppost because that is where the light is (but not the keys).' Bordass is now trying to establish 'a public interest organisation to help put all this back'.

Nevertheless, Bordass believes good work has been done on laying foundations, for example 'new professionalism', a cause he championed 10 years ago in *CIBSE Journal*. 'CIBSE's professional code requires members to promote sustainability, so surely you must understand how your buildings perform: the consequences of your actions. Building professionals should rise to the occasion, not just act in fear of being struck off,' he says.

'People will then learn from their mistakes, not keep repeating them, and report and share findings. This feedback will help to make buildings much more efficient – not by adding more kit, but by doing things better, as NABERS has confirmed in Australia. More thought, less kit is more sustainable too.'

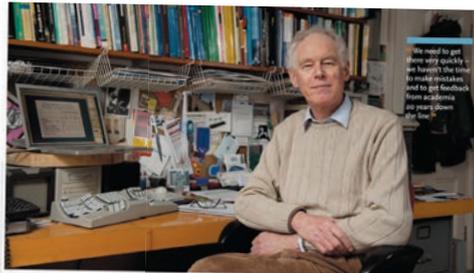
Another glimmer of hope is that the performance gap is 'better appreciated, if still not understood'. At a recent CIBSE event, Bordass was encouraged by the 'bright young people keen to do things differently'.

Having been ill since 2016, the 75-year-old is now firmly back in the swing, contributing to the debate from his platform at the Usable Buildings Trust charity. He fears humanity has left it too late to stop irreversible climate change, but is determined to do his bit to limit the damage, while also making buildings nicer for people too.

'Things are improving, but at nothing like the rate they should,' he warns. 'In many existing buildings (including new ones,) a tune-up can reduce energy use by typically 20%, with a further 20% from low-cost alterations. How about a "Saving Energy in a Hurry" project to crystallise these quick wins? It would cost less than one Hinckley, save more energy than the whole nuclear programme, and could be on-stream well before Hinckley even started up. Are CIBSE and its members up for it?' **CJ**



**Back to the feature:** Bill Bordass in 2019 charging his new hybrid car via his terrace home's coal hole, and, below, appearing in the first *CIBSE Journal*



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# CLIMB EVERY MOUNTAIN

Can a single BIM model be used from design to operation? Schneider Electric was keen to find out if true BIM was achievable at two flagship new buildings in Grenoble. The company's Bertrand Lack describes the not inconsiderable challenges to **Andrew Pearson**



TPôle is on target for LEED Platinum status

**S**chneider Electric promotes itself as a company leading the digital transformation of energy management and automation. So when it set out to construct two buildings at its site in Grenoble, France, it wanted them to achieve new standards for digital construction and low energy in operation – and, of course, to be a technological showcase for its products.

The buildings, which will accommodate more than 2,000 employees, are being constructed sequentially. Building one, TPôle, was completed last year and has a floor area of 12,000m<sup>2</sup>. 'We decided TPôle would be a flagship building in terms of energy performance that would also achieve the highest levels of user comfort through having a smart user interface,' says Bertrand Lack, director of strategy and innovation for the building division at Schneider Electric.

Lessons learned from the design, construction and operation of TPôle will be used to inform the design and construction of the second building, the 28,000m<sup>2</sup> XPôle. TPôle has achieved 80 Leed points (under Leed Version 3) putting it on target for Leed Platinum status, the highest level for energy-efficient design.

Schneider Electric's goal for XPôle is for it to be the first building to exceed 100 Leed points, with a target of 102 under the more

challenging Leed Version 4, for which 110 points is the maximum score possible.

The use of building information modelling (BIM) was fundamental to the low energy and operational aspirations for the design, construction and operation of TPôle. It wanted the project to be 100% BIM: from developing the design concept, through its construction and on to its operation in use.

## Operational BIM

In fact, Schneider wanted to use the 3D BIM visualisation model in conjunction with its building management systems to drive the operation of the building. 'We see a great advantage in connecting the database of static data in the BIM model to the dynamic building automation systems,' says Lack.

When the project was first mooted five years ago, it proved extremely challenging to acquire sufficient information from the BIM model for use in building management and automation systems, to enable facilities managers to interrogate and operate a building in real time. 'There is a real gap between the BIM used in the design stage and the BIM used in operations,' says Lack.

For this project, Schneider worked with Autodesk under a memorandum of understanding, to develop the BIM model so it would better connect to its building-automation software. As part of



General contractor GA and engineering consultant Artelia developed the BIM design

**“We see a great advantage in connecting the database of static data in the BIM model to the dynamic building automation systems” – Bertrand Lack**

that agreement, the facilities management stage of the project is now being intensively researched by both parties.

The project team of general contractor GA and engineering consultant Artelia developed the design for TPôle in BIM.

‘As a digital building management solution provider, we wanted to experience the design process in real life,’ says Lack. ‘We wanted to find out whether all the promises we had heard at various BIM conferences were true – that using it would enable the project team to save on costs during design and construction through improved collaboration, better coordination, planning and scheduling.’

One of the challenges of using BIM

is that information from the Revit work environment has to be exported into specialist software packages for each discipline – such as architecture, structural engineering, HVAC and electrical engineering – where these elements of the design can be developed. ‘We had seven BIM models,’ says Lack.

A difficult task on the project was getting the different software platforms to talk to each other. Industry Foundation Classes (IFCs) offer a global standard for construction elements that allow them to be described, shared and exchanged between software applications while maintaining a specific meaning.

‘As soon as you go out of one platform you face issues of data formatting,’ says Lack. ‘We faced some difficulties – which is normal for a state-of-the-art application – but we wanted to understand the issues.’

The BIM model was also used for thermal modelling. Dynamic thermal analysis of the building was done by EQUA, using its IDA ICE product, once the Revit model had been exported to IFC format. ‘We created an energy model based on performance of the building fabric to assess the passive behaviour of the building,’ says Lack.

‘We also created a dynamic model of the building and its controls, to simulate the behaviour of the building and the >>

### BUILT IN BIM AS DESIGNED

Although the design was developed in BIM, there were concerns that changes made on site while the building was being constructed meant that the final installation was no longer accurately represented by the BIM model. ‘Adjustments made on site were not reflected in the digital model,’ says Lack, who said the issue occurred mainly because the contractor was unfamiliar with the use of BIM in the operation of a completed building.

Lack says that the BIM model had to be updated after completion to take on board the changes made during the construction process.

‘The reality is that construction and operations worlds often ignore each other; this is a barrier Schneider had to work hard to counteract to ensure the BIM model accurately reflected the physical asset as its “digital twin”.



A digital representation of Schneider Electric’s TPôle building



“We wanted to find out whether all the promises we had heard at various BIM conferences were really true” – Lack



Lessons learned from TPôle will be used to inform the design of the second building, the 28,000m<sup>2</sup> XPôle, which is looking to exceed 100 Leed points

» MEP systems in use.’ The dynamic model was also useful in helping size the area of rooftop-mounted photovoltaic panels and their associated batteries, which would give Schneider a smart grid-ready building.

One of the company’s objectives with the project was to see how the as-built model could be used to operate a smart building. The plan was to map occupation, space management and alarm systems onto the BIM model, and create the building’s digital twin. To this end, the actual building has been flooded with sensors.

‘In addition to the active energy-efficiency solutions contributing to the optimal operation of the building and the achievement of our energy goal, this building is over-instrumented to collect as much data as possible. This enables it to work as a tool

for future research and innovation actions, energy-efficiency algorithms and analytics technologies,’ Lack explains.

As might be expected, TPôle is a showcase for Schneider’s BMS know-how. As such, it incorporates many of the company’s technologies, including EcoStruxure for Buildings – its architecture and building-specific platform for mass deployment of Internet of Things (IoT) solutions.

‘As part of the IoT aspect of the project, we have mapped some of the sensors – such as presence detectors and those for temperature – onto the BIM model,’ says Lack, who believes this implementation shows the value of putting the data into the building context: ‘If I say it is 25°C in office 64, that does not mean much – but if I show you, on the model, that its 25°C in the office in the south-east area of the ground floor of the building, that is far more useful to a facilities manager.’

Integrating the IoT will give more flexibility of control over the building’s temperature, lighting, air quality and even power usage. In addition, by collecting dynamic data from the building and coupling this with data from the static modelling, Schneider hopes to develop new functionalities and services for space-management operation, energy, maintenance, operations, and information on the occupants.

This connection of the static and dynamic data also allows the building to be visited virtually, in augmented reality. »

### WHY OPERATIONAL TECHNOLOGY IS KEY

To create an operational building model that can be accessed by facilities managers (FMs), another layer of technology must be incorporated in services designs, says Stacy Van Dolah-Evans, global account director at Schneider Electric, who spoke about the Grenoble project at CIBSE’s Build2Perform Live event in November.

The architecture allowing FMs to interrogate building asset performance in real time is known as operational technology. ‘We can’t get all the building information we need out of the existing IT architecture; we need more information and datasets,’ says Dolah-Evans.

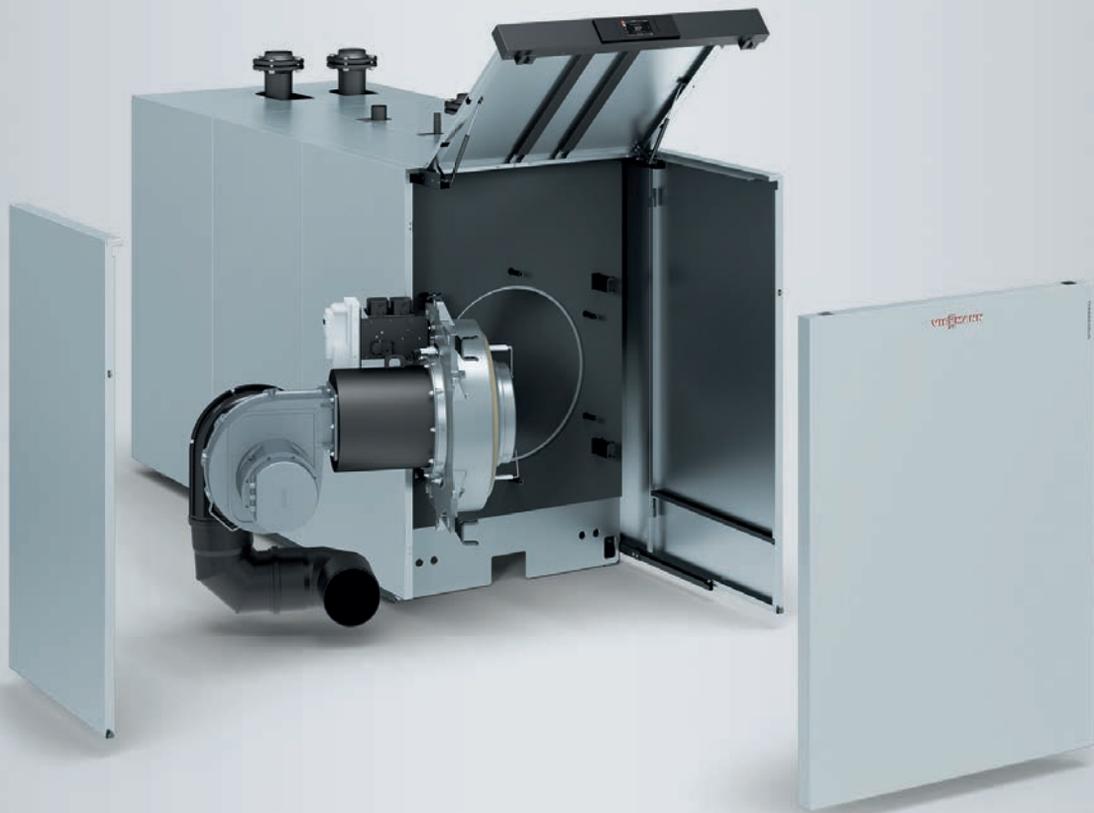
He adds that services designers need to diversify and increase their skills and knowledge in this area. ‘The industry has experts in different disciplines, but they don’t converge very often. That is a real problem, because most technologies converge all the time.

‘Mechanical engineers often don’t have knowledge of electrical engineering, so aren’t able to integrate controls that would enable data from M&E assets to be accessed.

‘Our industry needs to break down the silos; this will allow the changes to happen in how we approach building design.’

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» As a result of the extensive IoT architecture, equipment in the building can be controlled based on multiple criteria. TPôle is smart-grid ready – that is to say the technical installations, associated with the EcoStruxure system, can be energy flexible by shifting consumption times.

The system will, for example, make it possible to optimise the cost of energy by using dynamic pricing and load shedding – or through demand-response operations, whereby the building is taken off-grid at times of peak electricity demand. The system could even be used to optimise the building's carbon contribution.

'This flexibility will allow the consumption of energy to be shifted to times when energy is cheapest, which will help to lower our energy bill,' Lack says.

The BIM model being used by the facilities manager to operate the building requires far more detailed information than the IoT model needed by the building's users. 'The project has taught us how best to specify the BIM model, because the model required by the user is different from the one used by the FM,' says Lack.

**Tracking behaviour**

Candidly, he adds that it has been difficult to see the benefits of BIM for the construction phase of the TPôle project, because five years ago – when the project started – the contractors were not fully BIM conversant.

It was also a steep learning curve for all those involved: 'You cannot expect savings when you do your first BIM project,' says Lack. However, he believes the situation should improve now that ISO standard 19650 defines information management within a BIM design and construction environment.

Now that the TPôle building has been completed, Schneider is studying it in



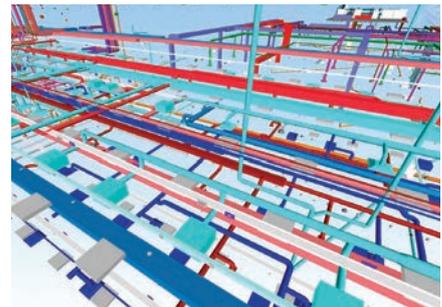
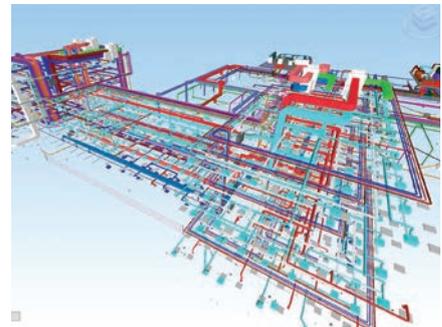
TPôle is smart-grid ready and can be taken off grid during peak electricity demand

operation, to understand better the algorithms and features needed to optimise its energy consumption.

'With this dynamic model, we have the capacity to track the actual behaviour of the building and to compare it with the virtual building, to see if implementing different control scenarios can improve performance.

But will it reach the target of 45kWh·m<sup>2</sup>·per year? 'It's still too early to tell, because we need at least a year's operation to validate the model to see if it is good,' says Lack.

Information from the operation of TPôle will inform construction and operation of the second building, work on which is already under way. The aim is for it to have an annual energy consumption of just 37kWh·m<sup>2</sup>·per year, roughly a quarter of the office average energy consumption in Europe – not bad for a building in a city such as Grenoble, where the average temperature in January can dip below freezing. **C**



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# CLOSING THE GAPS

Guidance on energy and ventilation regulations must be more integrated, say researchers, after their study of UK airtightness tests showed air permeability is often too high for MVHR systems to work optimally. **Alex Smith** reports

One of the key recommendations in Dame Judith Hackitt's report on building regulations, after the Grenfell Tower fire, was the integration of regulatory guidance for different building systems. In the *Independent Review of Building Regulations and Fire Safety*, Dame Judith said the current Building Regulations and the associated suite of Approved Documents 'can lead to design and construction being seen as a set of siloed requirements'.

She recommended an over-arching Approved Document that ensures there are no conflicts between the different sets of guidance. Approved Documents designed in isolation had, Dame Judith said, led to situations where changes are made to one aspect of a building 'without sufficient consideration of the secondary effect'.

In December, the government announced its Hackitt Implementation Plan and, in paragraph 2.36, revealed that it would carry out a joint review of three Approved Documents: Part L (Conservation of fuel and power), Part F (Ventilation) and Part M (Access to and use of buildings).

That a siloed approach to one building regulation can lead to an unintended consequence for another was made clear in a UCL paper that examined the relationship

## SEALING THE DEAL

A 2017 study<sup>2</sup> of the ATTMA test results by the paper's authors found evidence that a proportion of homes was being made airtight while being tested, as there were very precise achievements of targets for a high number of dwellings (see Figure 1). 'This suggests the existence of a combined process of sealing and measurement, where sealing can stop as soon as the design target is reached,' said the authors. The ATTMA test standard places strict limitations on the amount of sealing that can take place during a test.

between airtightness (Part L) and ventilation (Part F) in new UK dwellings.<sup>1</sup> The research, which included analysis of almost 200,000 airtightness tests, indicated that homes with mechanical ventilation with heat recovery (MVHR) were using more energy than necessary. It found that developers were adhering to Part L and Part F, but – as these regulations are only loosely linked – they allow mechanical ventilation systems to be installed in dwellings with air permeability that is too high to get optimal performance from the ventilation.

The paper looked at the relationship between airtightness (designed and measured) and the ventilation strategy – in the regulations and in practice. A regulatory airtightness test has been present in the UK since 2006, and requires a design air-permeability target be set for a building, which is tested at completion. Regulations only need a sample be tested, but data indicates that three-quarters of new dwellings are tested, according to the researchers.

The study data was obtained from the Air Tightness Testing and Measurement Association (ATTMA), one of two competent persons schemes for airtightness testing in the UK, which created a mandatory lodgement scheme for air permeability tests in 2015. Researchers were given 192,732 test records collected from August 2015 to December 2016. These comprised the pressure test results in  $\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa, plus other data, including the air permeability design target and adopted ventilation strategy for each building.

The latest paper focused on the design targets and their relationship to the ventilation strategy, which were predominantly natural ventilation (86,678 samples), MVHR (36,906) and mechanical extract ventilation (15,543).

It found that there was little difference between the design airtightness for each ventilation strategy, and that 73% of MVHR homes have design airtightness  $\geq 5\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$



**"Using MVHR in a building with leaky fabric has fairly serious consequences in terms of CO<sub>2</sub> emissions"**

at 50Pa, which is regarded as too leaky to get the most out of the MVHR system. ATTMA documentation suggests there should be a difference of  $2\text{-}3\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  between good practice MVHR and naturally ventilated dwellings. By contrast, the analysis of ATTMA data showed that MVHR homes had air permeability only  $0.46\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  lower than naturally ventilated dwellings.

Natural ventilation strategies would be expected to have higher design air permeabilities, say the researchers, so that infiltration through the building fabric can be



combined with trickle vents and intermittent fans to supply adequate fresh air. MVHR systems would be expected to be used in more airtight buildings, with the mechanical ventilation system providing the majority of fresh air supply to the dwelling. A leaky building would mean energy being wasted, heating more incoming air than necessary.

There are a few reasons for this, according to the researchers: greater electricity use as more incoming air than needs to be is heated; and, possibly, air flowing through the wrong paths in the home.

Analysis of the tests revealed that 17% of naturally ventilated dwellings have design airtightness below five. This is permitted in the regulations, subject to sufficient extra trickle vents, but the researchers question whether this is leading to sufficient air quality.

### CO<sub>2</sub> consequences

The study looked at the impact of air permeability on modelled CO<sub>2</sub> emissions with different ventilation strategies. Figure 2 shows

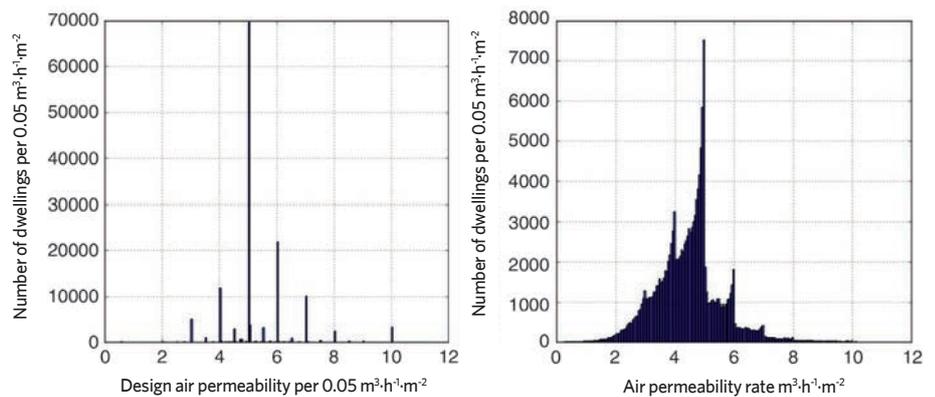


Figure 1: Design and measured air permeability for dwellings in the ATTMA dataset

the calculated CO<sub>2</sub> emissions for a typical-sized mid-terrace house with either MVHR or natural ventilation. Using the most common design air permeability in the ATTMA dataset for dwellings with MVHR, it was calculated that there would be an annual CO<sub>2</sub> saving of 6% for a design target of 3m<sup>3</sup>·h<sup>-1</sup>·m<sup>-2</sup>. A target of 1m<sup>3</sup>/m<sup>2</sup>·h would save 11% of annual CO<sub>2</sub>. If the building met Passivhaus standards, 0.5m<sup>3</sup>·h<sup>-1</sup>·m<sup>-2</sup>, there would be CO<sub>2</sub> savings of 12%.

The study also looked at the consequence for buildings that failed to meet their design targets. If the design air permeability is increased from 5 to 10m<sup>3</sup>·h<sup>-1</sup>·m<sup>-2</sup> – the maximum allowable under regulations – it leads to an increase of 18% and 8% for MVHR and natural regulation respectively. Using MVHR in a building with leaky fabric has fairly serious consequences in terms of CO<sub>2</sub> emissions, say the researchers.

### Recommendations

To align air permeability more closely with ventilation strategies within the regulations, the authors made a number of suggestions. One requires builders to commit to a design airtightness range, before directing them to

an appropriate ventilation strategy for any given airtightness. The authors say specifying a range for air permeability offers flexibility in the design and construction process.

A more radical approach, says report author Jenny Crawley, is to follow the European approach of making the fabric as airtight as possible and putting in mechanical ventilation. However, the study cites research that shows the low air permeability required for MVHR to work well is often challenging in the UK because of issues around installation, commissioning and performance.

The government's commitment to look at Building Regulations more holistically has been welcomed by CIBSE's technical director Hywel Davies: 'It allows ventilation and airtightness to be considered in a systematic way, as well as allowing us to consider how ventilation delivers reasonable air quality in occupied spaces.' [C](#)

### References:

- 1 Crawley J, Wingfield J and Elwell C, *The relationship between airtightness and ventilation in new UK dwellings*
- 2 Love J, Wingfield J, Smith A et al, *Hitting the target and missing the point: analysis of air permeability data for new UK dwellings and what it reveals about the testing procedure*, Energy Build 2017

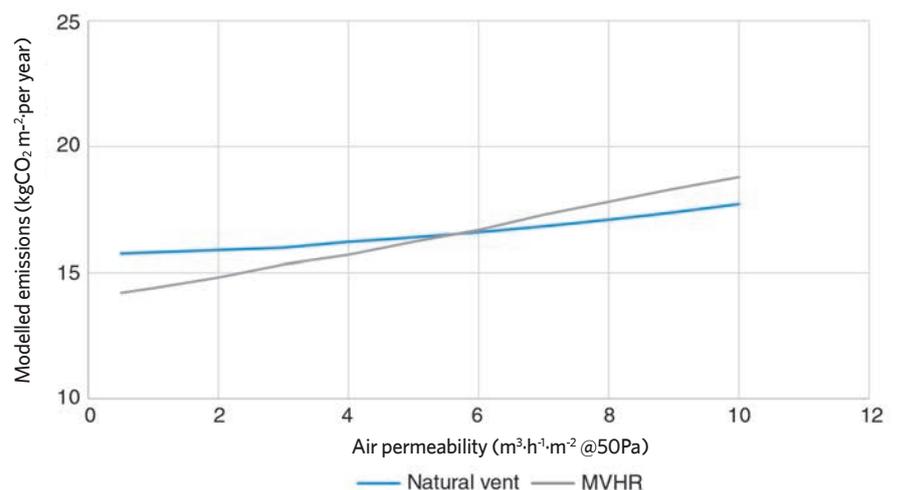


Figure 2: Carbon emissions for an example dwelling at different air permeabilities and with different ventilation types



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# BURIED TREASURE

CIBSE's academic journal *BSERT* celebrates its 40<sup>th</sup> anniversary in 2019.

**Tim Dwyer** has been researching the archive of its pre-digital predecessors and found there is much that today's engineers could learn from long-forgotten studies carried out between 1950 and 1980

**A**ll CIBSE members have free, online access to the two learned journals of the institution – *Building Services Engineering, Research and Technology (BSERT)* and *Lighting Research and Technology (LR&T)*.

Both journals offer a cornucopia of knowledge that is an unparalleled resource for practitioners, researchers and students. In 2019, *BSERT* celebrates its 40th year of publication and the complete legacy of material is freely searchable and accessible to CIBSE members through the web page [www.cibse.org/Knowledge/Online-Access](http://www.cibse.org/Knowledge/Online-Access)

*BSERT* was developed on the strong foundation of papers published in the antecedent *Journal of the Institution of Heating and Ventilating Engineers (IHVE)* – the previous incarnation of CIBSE from 1933 to 1972 – and, for the following seven years, in *Building Services Journal (BSJ)* the immediate predecessor of the *CIBSE Journal*.

However, papers published before 1980 and the establishment of *BSERT* are not readily available in a digital format – and, almost certainly, not accessible as searchable text. So they are hidden from the internet search engines and web spiders that are the staple of the formative research resources for many contemporary scholars.

But does that matter? In the fast-moving technological world of 21st century building systems, some might argue that it is not particularly effective to reach back to papers from the pre-digital age. Currently, this requires a trip to a library, to trawl through poorly indexed printed documents. So I took that trip, to spend a few days reading through archived documents and develop an opinion, somewhat partially, of the value of non-digital materials to the 21st-century researcher. To make the task manageable, I constrained my reading to papers published after 1950.

I was soon taken aback by the variety and modern-day relevancy of much of the published material. The papers encompass the vast breadth of activity that constitutes 'building services engineering' and many of the authors – particularly in the earlier years – were experienced practitioners.

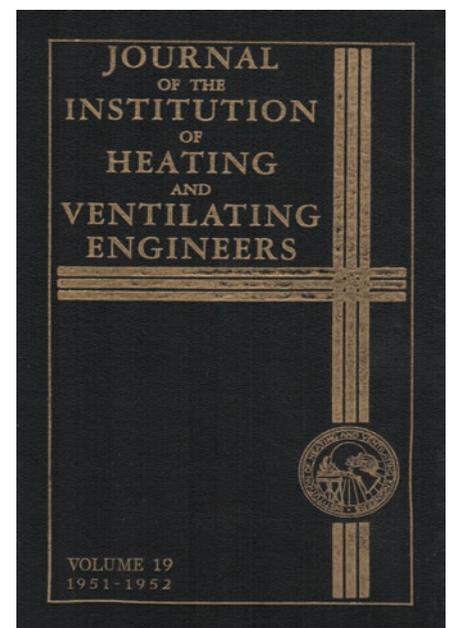
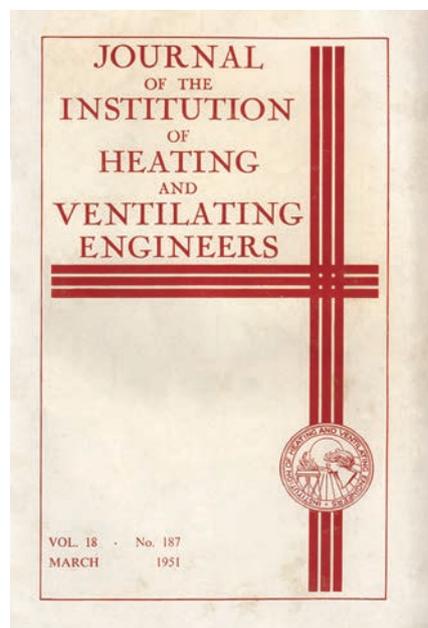
Papers typically included considered analysis and development that was supported by appropriate and comprehensible science, engineering and mathematics. Although authors may have been limited in the opportunity to undertake repetitive and iterative methods offered by modern digital computers, they employed techniques that benefited in their reporting from not being obfuscated by 'black-box' digital modelling and simulation techniques.

To give an impression of the relevancy of the materials, and to whet your appetite for undertaking your own research, I offer a glimpse of just a few of the many topics below. A complementary article to this – that considers other aspects of the non-digital legacy – will be published in the March 2019 issue of *BSERT*.

## Comfort

Bedford's 1954<sup>1</sup> paper provides a compendium of fundamental thermal comfort knowledge and, together with the extended discussion, develops the groundwork for the comfort temperature scales that are in common use today. The 1970 paper<sup>2</sup> by Humphreys was a clear portent – as well as one of the drivers – of the profession's change in the measurement and specification of internal conditions to embrace a range of comfort conditions, rather than a single design comfort temperature, particularly when there are opportunities for personal adaptation.

School environmental conditions studied by Langdon in 1970<sup>3</sup> indicated that thermal discomfort was associated with room orientation, structural weight and the occurrence of noise. The prevalent lightweight-designed, single-sided glazed classroom was in need of more effective means of solar shading and ventilation.



Two volumes of the IHVE journal from the early 1950s. Such non-digitised material can still be useful to researchers

In the early 1970s, several papers developed the ideas popularised by Ole Fanger's comfort research, including the one by McIntyre in August 1974.<sup>4</sup> This considered the effect of the variations in internal temperatures (an attribute of the increasingly prevalent lightweight buildings of the era) on occupant comfort and related this to the recently developed comfort concept of predicted percentage of dissatisfied (PPD).

Mike Humphrey's 1971 study<sup>5</sup> of secondary school children's summertime comfort gives a comprehensive account of the research and analytical work undertaken to relate to the children's attire and external temperatures, so as to determine appropriate temperature ranges for the majority of occupants to suffer least discomfort. This is an early example of research that would lead to adaptive comfort criteria.

### Indoor air quality

Mulcaster's paper,<sup>6</sup> published in 1966, gives an exceptionally thorough grounding in filtration for ventilation systems. The example air samples in UK cities showed high levels of particulates, especially in Edinburgh, where the PM<sub>2.5</sub> levels were notably high – presumably because of the environmental impact of 'soot' from predominantly coal-fired heating systems.

The paper indicates that there was already an appreciation of the long-term health effects of small particulate matter.

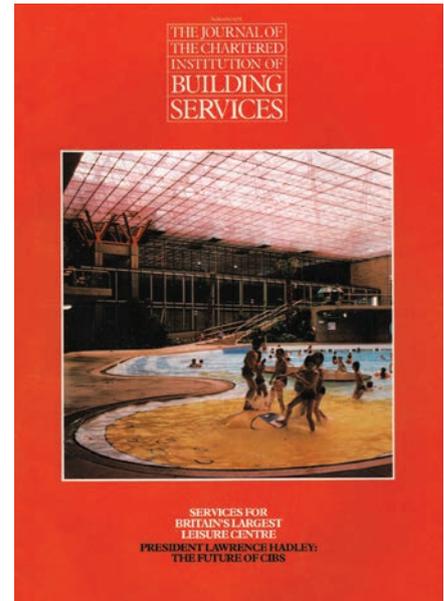
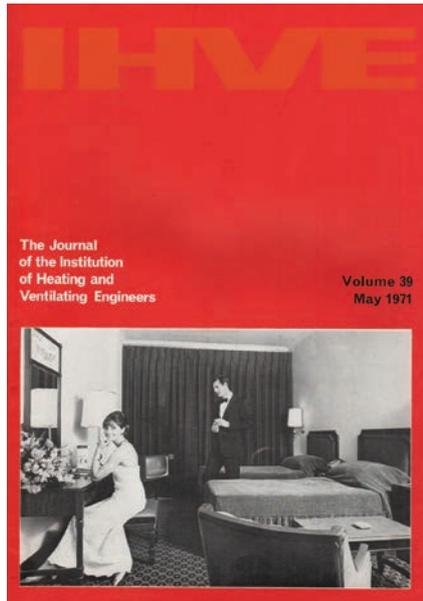
Unfortunately, the expectation of Craxford, in the 1973 paper<sup>7</sup> on air and water pollution, may be thought of as being rather complacent when considering pollution from motor vehicles. It states that 'pollution by smoke from diesel vehicles is a very simple matter to deal with, as no smoke nuisance arises from a properly adjusted and well-maintained diesel that is being used properly'.

Similarly, the apparent lack of urgency given to the removal of lead from petrol for health reasons – with more concern about the potential effect on the petrol supply chain – dates this paper more than any other that I read.

### Building thermal assessment

Danter's 1960 paper<sup>8</sup> gives a comprehensive account of the simpler methods to assess the alternating transmittances and time lags for building structures under dynamic conditions. He develops an approximate method (based on Mackey and Wright) to allow the characteristics to be developed from the thickness of a single-layer structure and includes a useful rule of thumb.

WP Jones authored many papers over the years. In 1963, his consideration<sup>9</sup> of the



A glamorous photo accompanies a 1971 edition of *JIHVE* (left) and the *CIBS' Journal* concentrates on leisure centres

**“Mulcaster's paper, published in 1966, indicates that there was already an appreciation of the long-term health effects of small particulate matter”**

### CURRENT ISSUE

The January 2019 issue of *BSERT* includes an article by Derek Croome that reprises the very first article published in *BSERT* in January 1980, also by Croome that considers methods of measurement and assessment that provide feedback data for sustainability and, as is currently increasingly the focus, the application to health and wellbeing rating assessments. The latest issue is at <http://bit.ly/CJFeb19BSERT>

start-up process of an air conditioning system is a prime example of his ability not only to conceptualise a practical system with the appropriate physics and mathematics, but also to fully and clearly explain his thinking, and the required method of solution. His elegant application of a simple decay function was employed to establish the conditions in a room under constant heat gain.

In March 1953, J C Weston<sup>10</sup> gave an extensive account of the monitoring of a contemporary lightweight school as a means of exploring the performance of the buildings and the potential for energy saving, with – for example – the most effective location of the sensor for adjusting the boiler flow water temperature that supplied the warm air heating system.

The comprehensive analysis of temperature gradients and ventilation effectiveness made reference to Yaglou's classic work (undertaken in the 1930s) that is still regularly referred to today. **CJ**

**TIM DWYER** is an independent consultant, visiting professor in building services systems at University College London, and technical editor of *CIBSE Journal*

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- 10 Weston JC 'School heating research' *JIHVE*, March 1953

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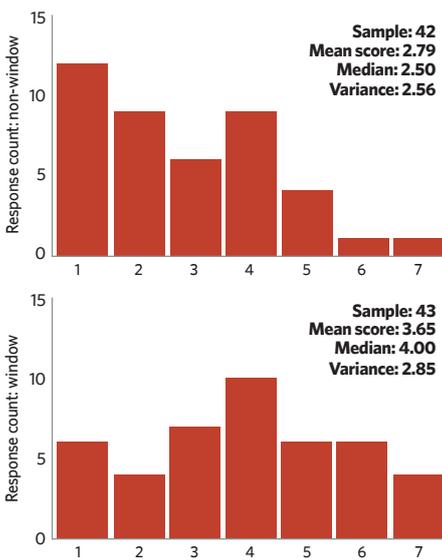




# MEASURE OF SUCCESS

So you want to conduct an occupant survey in a non-domestic building? It requires more thought and skill than you might think, and good design may prevent you jumping to the wrong conclusions, says **Roderic Bunn**

Scores for control ventilation by window location



Control of ventilation 1: No control, 7: Full control

**Figure 1:** A good-practice example of how to show data in stacked histogram format to illustrate differences in ventilation control perceptions between window and non-window seats. All statistics are given for total clarity. Note that spatial differences can lead to skewed or flat (non-normal) distributions. This is not a failing, rather a normal characteristic of occupant perceptions. An understanding of what the data is saying requires the researcher to have a full grasp of the building's physical context

**P**eople are a problem. The humourist Guy Browning wrote that most problems in life are people problems, and most people problems are communication problems. If you want to solve a communication problem, he said, go give someone a damn good listening to.

The key to understanding what people experience in buildings is to ask them clear, unbiased questions. The more abstract, enigmatic, or technical a question, the greater the variation in the answers.

This is compounded by the fact that humans are emotional, diverse and perverse. This makes accurate surveying of building occupants tricky.

Hence the market for environmental instrumentation. Reliable, low-cost, and accurate digital devices can measure most environmental parameters. Their drawback is an inability to record conditions as perceived by humans. Nor can they rank trade-offs that humans make, such as between ventilation and external noise, or ventilation and draught from an open window.

Ultimately, it is human perception of conditions that determines comfort and motivates behaviour, such as opening or closing a window, not an instrumented value. Like an ill-fitting suit, instrumentation and perception data tend to fit only where they touch. It's why proof of causal links between measured environmental parameters and productivity remains elusive.

Anyone can design a survey, but the difference between a bad questionnaire and a good one is the difference between a novice and a virtuoso. Most people can bash out Chopsticks on a piano, but performing a concerto is another level. When it comes to creating a good survey, there is simply no substitute for formal study and experience. Conversely, a badly designed survey risks leading you to jump to the wrong conclusions.

## Creating a questionnaire

**Rule One:** read a book on how to do it. There are many guides on designing social surveys.

**Rule Two:** Be clear what your survey is about. Do you want it to be specific or cover a wide range of comfort factors? The best surveys are those that have a particular research focus, be it thermal comfort, acoustics or health (see Figure 2 'A map of typical occupant surveys'). It's possible to develop a general built environment questionnaire, but it takes talent to avoid breaking Rule Three, which is: keep it short. Respondents start to suffer survey fatigue after three A4 pages or web screens.

**Rule Four:** Test your survey before unleashing it on the world. Practise it with volunteers and ask them what they thought the questions were about. Only a couple of people in any one survey might express misgivings about a particular question you've posed, which is why it takes 10 or 20 surveys before a consistent pattern of confusion emerges. Once realisation dawns, you'll



“The difference between a bad questionnaire and a good one is the difference between a novice and a virtuoso”

have to bin the data you’ve gathered, shortly followed by the offending question.

**Survey scales**

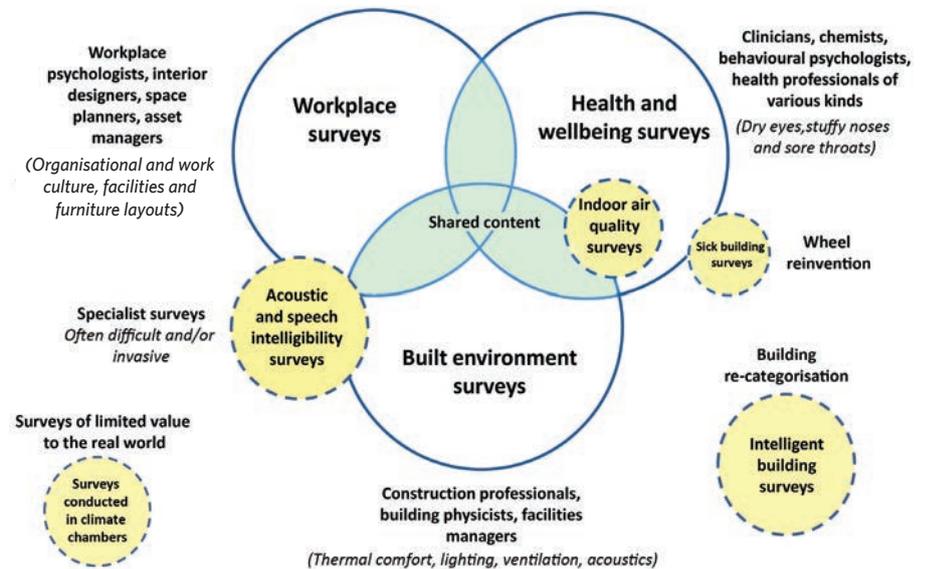
Survey designers use scales to elicit occupants’ graded perceptions of comfort and functional factors of buildings. The simplest scale is the yes/no binary choice. That suits factual questions, such as whether or not a respondent sits by a window, but it’s not very insightful for obtaining a range of views. Hence the use of Likert scales and semantic differential scales (see Figures 3-5).

Two rules here: be consistent with your scales so scores from different questions can be compared. Also, uneven scales, such as 1-5, 1-7 or 1-9, provide a midpoint for respondents to give a neutral response. Even scales (e.g. 1-4, 1-6) that force respondents to respond either negatively or positively will bias the data.

Overall, seven-point scales offer the best balance for a respondent to express their perceptions and enough resolution for statistical analysis. Scales above nine-

**A map of typical occupant surveys**

Figure 2: Below shows the different forms of surveys used in building performance analysis, the professionals who tend to develop and use them, and how their questions tend to be themed. Inevitably there is overlap. Some survey systems are specialised, such as for acoustics, or are a subset of another theme, for example, those studying ‘sick building syndrome’



points may create doubt about which box to tick, which raises the chance of scoring by guesswork. That increases the variance in responses which consequently reduces the underlying precision in the averaged scores (and thereby reduces the explanatory power of the statistics), without the surveyor being aware of it.

Survey questions must also be suited to the respondent. Construction professionals are more knowledgeable about technical topics than building users who may only be able to describe discomfort symptoms and are unable to link them to specific causes. The use of technical terms in a question, such as ‘acoustics’, ‘occupant density’ or ‘ICT’ may be misunderstood or misinterpreted.

Scale labels must be true antonyms – for example, unsatisfactory/satisfactory, or too cold/too hot. Using scale labels that are not opposites is the equivalent of combining two questions into one. For example, ‘interferes’ is not the opposite of ‘enhances’, yet this appears in a well-known questionnaire.

**Text boxes**

Comments in surveys are usually far more insightful than scores. Most questions should be equipped with a (preferably small) free-text box so that people can qualify their scoring.

There can be a difference between what respondents score and what they say. >>

**FIVE BAD SURVEY PRACTICES**

1. Leading questions or statements, such as ‘I am often too cold in winter’. This can motivate survey respondents to give negative responses – a characteristic known as ‘acquiescence bias’. Leading questions followed by a multiple series of questions of discomfort (as in ‘tick all that apply’) can serve to exaggerate the seriousness of a discomfort problem. Some researchers do this deliberately to get the answers they want.
2. Mixed scales are pointless, and scales without midpoints deliberately incite bias.
3. Scale labels that presume a problem as in ‘slight problem/major problem’. Wherever a respondent scores, it’s still classified as a problem.
4. Combining multiple variables in a single question where the respondent can only respond once (for example, satisfaction with catering and toilets).
5. Questions that ask respondents whether they are ‘satisfied’ with a singular and obviously negative characteristic, like draught, when they should be asked to rate between two opposed conditions, eg stillness and draughtiness.

» Scoring will be driven by the questionnaire's themes and your choice of questions. Text boxes, however, give respondents free rein.



**Carrying out a survey**

Success depends largely on how a survey is carried out. Raise awareness among building occupants so they welcome you with open arms rather than indifference or resistance.

High survey response rates require honed communication skills. Be polite but insistent when asking people to take part. Changes to data protection legislation require respondents to opt in formally.

Surveys should be carried out over a single day, in case conditions change. You need enough resources to hand out and gather up paper questionnaires. One person can feasibly survey 500 people in a day. For populations above 600 people – or multiple tenancies above 300 in total – budget for two surveyors.

You should always aim for a 100% response rate of the people in the building on the day. Be pleased with anything above 80% and content with 60% and above. A 40% response rate will generate shaky statistics.

Web-based surveys may be needed for large buildings, or those where access or security is an issue. Elsewhere a paper-based

survey should be the default. It may require more work, but you get to speak to the occupants directly, and you experience the building yourself.

Web-based surveys tend to generate lower response rates than paper-based surveys, which is why some people devise incentives. However, any form of incentive, such as prize draws, runs the risk of introducing hidden bias in responses. It might also motivate people to cheat – for example, some people might use multiple email accounts to increase their chance of winning a prize.

Keep data analysis simple. There are many analytical and statistical tests suitable for survey data. However, as respondents are delivering whole integer scores on a small categorical scale (for example 1-7), attempts to transform it in any way might fatally distort it. Some surveyors indulge in complex transformations to turn non-normal distributions into normal distributions (bell-shaped curves) so the data is parametric. However, in building studies, non-normal distributions describe how occupants perceive actual conditions. They are insightful distributions. Normalising them is unhelpful.

The mean value of a distribution and its variance (a measure of data dispersion that may be insightful) should be calculated, and always reported in any graphs along with the sample size (Figure 1).

**Further reading:**

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*Surveys in Social Research*, 5th edition, Routledge,

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*Qualitative Research Practice*, NatCen, SAGE

(Second edition), Ritchie, J., et al. (2014)

■ **DR RODERIC BUNN** is a consultant in Soft landings, energy analysis and occupant surveys.

Figure 3: An example of a semantic differential bi-polar rating scale used in many occupant surveys. So-called, as the respondent is required to translate their subjective perceptions of a range of conditions into a numerical score. This enables direct translation of perceptions into statistics. Used notably in the Building Use Studies (BUS) occupant survey

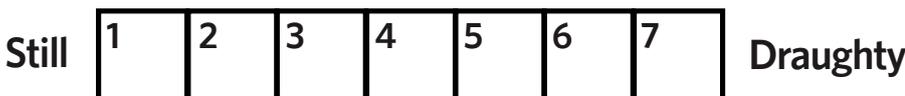


Figure 4: Examples of abstract response scales using terms or icons. This is a form of attitudinal or Likert scale, with or without numerical references. Many built environment surveys favour these scales, as scaling intervals based on emotions are believed to help respondents rank their subjective feelings towards conditions

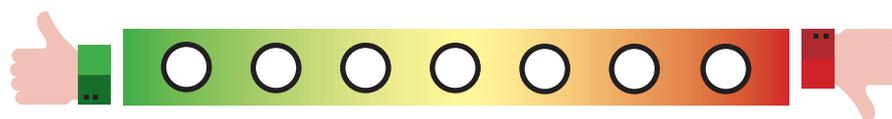
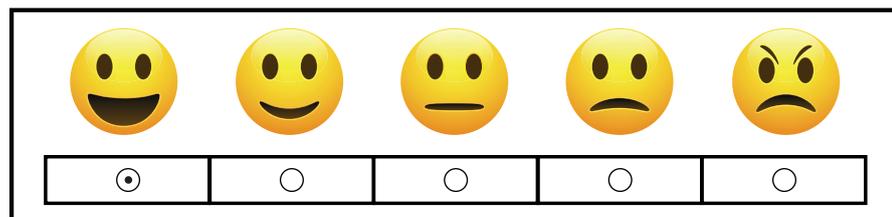
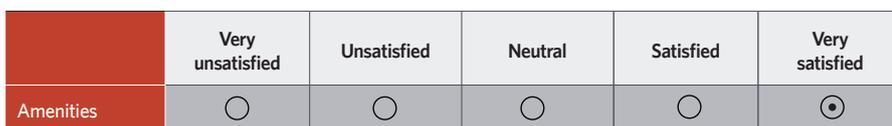


Figure 5: A version of a semantic differential scale where a respondent is required to select their opinion on a seven-point scale between two polar adjectives (not shown). The green and red tinting implies a sliding scale between good and bad. This scale is used in the CBE survey available from Berkeley University California (certified by Well and Leed, so has the same status as BUS)

**Free-text analysis**

Comments are best kept in their original form rather than subjected to some form of thematic analysis, as comments can easily be re-categorised into themes chosen to suit the ambitions of a researcher. Again, this is a form of bias. In any case, thematic analysis is best for longer tracts of feedback.

Word clouds are often used to display comments. They are compelling to look at, but these can be prone to error if no attempt has been made to resolve subtle differences, such as 'too hot' and 'a little hot'.

It may be insightful to categorise free-text responses as positive or negative, with a balanced category for any comments that are neutral or only mildly critical. People are generally more motivated to complain rather than to praise. People who are happy generally don't make comment.

Which brings us back to the beginning: ask people a sensible question and they tend to give you an honest answer. It may not be the one you want or the one you expected, but that's why perceptions gained from occupant surveys are so important: they tell us what we need to know, not serve to confirm the surveyor's expectations. **CJ**



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# EN12101-3:2015 – full compliance delivers safer buildings

Full compliance with this enhanced smoke and heat-control systems standard will drive increased safety for building occupants, says **Andy Cardy**

**O**n 8 April 2017, the smoke and heat-control systems standard changed to include the option to use frequency converters during a fire event. This revision, we believe, is a real game changer, as it offers designers more solution possibilities and significantly improves building occupant safety.

Full compliance with this revised standard means that we can offer all three solution choices defined within the standard. So the designer can choose from the following:

- Fully tested and certified high-temperature fan/VSD range (ducted and thrust fan variants)
- Bypass the VSD during a fire event
- De-rate fan-drive motor by 20% and fit voltage waveform filter

## Fully tested and certified high-temperature fan and VSD range

Having successfully completed third-party testing of our core fan range, we are proud to confirm that Fläkt Woods, together with Danfoss Drives, are the first to announce a fully certified EN12101-3: 2015 packaged HT fan and VSD solution in the UK and Europe.

This VSD fan-control solution is the most practical, flexible and cost-effective one as it removes the need for oversizing fan-drive motors and having to fit a voltage waveform filter (although this could still be considered). Reliability of a dual-mode fan and matched VSD package is also higher, as fire-mode fans are effectively

“run tested” every day. Dedicated fire-mode fans are typically only tested a few times a year.

As full compliance requires fan manufacturers to undertake extensive third-party fan testing with VSDs as an integral part of the solution (rather than being just an accessory), this HT fan certification revalidation process represents a significant time and resource commitment.

To ensure delivery of the best possible customer solution, Fläkt

Woods teamed up with leading VSD manufacturer Danfoss Drives. Both companies, with a total of 150 years’ experience within the HVAC industry, are passionate about quality, excellence and fire safety.

When delivering a robust and reliable smoke-extract fire-safety solution, there are two significant factors to consider.

First, correct axial fan design is critical, especially related to its core component, the impeller, as this is vital to ensuring overall product integrity



Car park jet-thrust fan - hot smoke test

and reliability. One key factor here is the gap between the fan casing and impeller blade tip (to allow for material expansion at elevated temperatures), but accurately assessing operating component stress levels is the most significant factor when ensuring durability of any powered smoke-extraction solution. The fan-drive motor design and specification (especially bearings) is another very significant design factor that influences overall product reliability. The second solution element is the VSD. Historically, system designers have often opted to switch out or bypass the VSD during a fire event, but using a VSD during an emergency smoke extraction event is becoming more desirable, as they add more control flexibility to ensure that smoke control and extraction performance is optimised.

### Bypass the VSD during a fire event

Bypassing the VSD during a fire event does, on the face of it, provide a more robust solution, but doing this would force the fan to run at full speed. If

the fan is used within a pressurisation system, then doing this could cause component damage, by over-pressurising them. Worst still, over-pressurising stairwell pressurisation systems would have very serious consequences, as this may then make it impossible for occupants to open escape-route doors. In addition, not using a VSD would make it much more difficult for the system designer to achieve desired smoke-control and extraction strategies.

### Using a non-certified fan and VSD package during a fire event

EN12101-3:2015 allows VSD speed control for a dual-mode fan, even during a fire event, but unless the fan, drive motor and VSD have been third-party tested and certified, the drive-motor rating must be increased 20%. In addition, the installer must fit a voltage waveform filter between the VSD and motor.

The issue here is mainly cost and practicality, as voltage waveform filters are very expensive, often costing more than the VSD. In addition, as these should be housed inside a remotely

mounted control panel, the enclosure needs to be larger, while extra wiring would also be needed. As the fan-drive motor must also be larger, fan cost will increase, while higher amp ratings could impact on wiring and control-equipment ratings and costs.

Our Fläkt Woods and Danfoss Drives packaged solution is a fully certified axial fan range with matched VSDs and offers enhanced protection, reduced risk and lower installation costs.

■ Andy Cardy is product manager - Axial Fans at Fläkt Woods Limited UK. For further information, visit [www.flaktgroup.com](http://www.flaktgroup.com)

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## FROZEN, THE SEQUEL

Sweden's famous IceHotel, in Jukkasjärvi, has been certified an eco hotel by the Nordic Swan Ecolabel, Scandinavia's most comprehensive eco-labelling programme.

While keeping the hotel open during the freezing winter months is no problem, achieving year-round status requires a bit more thought. IceHotel 365, which opened in 2016, is made from ice blocks on the inner walls, but the exterior walls are made of concrete and covered with a mixture of ice and snow.

To keep the indoor temperature at -5°C, IceHotel 365 uses the natural cold via steel pipes drilled into the permafrost, five metres underground. The building is thoroughly insulated so it won't let the cold out or the heat in – essentially like a thermos.

Meanwhile, 600m<sup>2</sup> of solar panels on its roof power the refrigerating plant. Jukkasjärvi is 200km above the Arctic Circle and, in summer, the sun shines for the equivalent of 100 consecutive days. The panels generate 130,000kWh per year.



The all-year round IceHotel has been certified by Nordic Swan Ecolabel

## F-Gas phase-down going to plan within Europe

### Associations demand better enforcement of refrigerant rules

The EU goal to phase down the use of fluorinated greenhouse gases (F-Gases) remained on track in 2017, according to the latest annual update by the European Environment Agency (EEA).

The EEA report *Fluorinated greenhouse gases 2018* assesses the progress made under an EU-wide phase-down of hydrofluorocarbons (HFCs) over the past year. These man-made chemicals are used in everything from refrigerators and heat pumps to air conditioners.

The reduction in the use of F-Gases is being done through a system of annual quotas allocated to producers and importers. In 2017, the EU-wide placing on the market of HFCs stayed below the overall market limit for the third year in a row, by 0.4 per cent.

Meanwhile, the European Partnership for Energy and the Environment (EPEE)

and three leading associations in the heating, ventilation, air conditioning and refrigeration (HVACR) sector – EFCTC, AREA and ADC3R – have joined forces to demand better enforcement of the EU F-Gas Regulation.

As growing illegal trade of refrigerants is reported, the associations have called on all market players to buy refrigerants only from reputable sources to ensure the safe and efficient operation of HVACR equipment. In cases of accidents that may result from the use of unknown substances in illegally imported containers or cylinders, installers will ultimately be responsible.

Andrea Voigt, director general of EPEE, said: 'There is no need for illegal imports. Sustainable and lower GWP refrigerants and technologies are available today to contribute to meeting the requirements under the F-Gas Regulation.'

### California bans HFCs

The state of California, USA has unilaterally banned several hydrofluorocarbon (HFC) refrigerant gases widely used in cooling systems, because of their high global warming potential (GWP).

The California Cooling Act applies to new and retrofit equipment from the start of this year. Manufacturers can no longer sell equipment using prohibited refrigerants manufactured after 1 January. High GWP gases, such as R404A and R507A, are no longer permitted in supermarket systems, condensing units and self-contained units.

The Act also establishes an incentive programme for early adoption of low-GWP technology in refrigeration systems, with state legislators aiming to reduce HFC emissions by up to 17 million tonnes CO<sub>2</sub> equivalent annually by 2030.



# Studies target Symposium

There are only two months to go until the 2019 CIBSE Technical Symposium gets under way at the University of Sheffield.

The 9th CIBSE Technical Symposium, from 25-26 April, will be an opportunity to examine and share research, development and applications that will drive change in the regulation, creation and maintenance of the built environment (<https://cibse.org/symposium>). It will also present evidence of where there are still clear opportunities to benefit from established practices. Four papers on cooling are currently being reviewed by the symposium planning committee. They are:

## 'Cooling with heat recovery for electrical cable tunnels in cities' – Gareth Davies, London South Bank University

This paper explores how additional active cooling may be applied to reduce temperatures in tunnels running under cities, allowing higher electrical loadings to be used. With electrical power often distributed by underground cable tunnels, significant quantities of heat are often generated within them, increasing tunnel air temperatures.

These are generally controlled using outside air introduced through ventilation shafts and circulated by fans to prevent overheating of the cables and to enable service/maintenance personnel to access the tunnels. The paper looks at a preliminary study, focusing on London, that investigates using a heat exchanger to extract heat from the outside air

entering the ventilation shaft. The low temperature heat extracted can be upgraded using a heat pump to a temperature level that enables its use in a district heating system. Carbon and revenue cost savings are also discussed.

## 'Overheating in residential developments: a comparative study highlighting how evaporative cooling can address this inefficiency' –

Laurence Cockman, Colt International

This looks at how a comparative study of identical developments gave the opportunity to assess evaporative cooling solutions to overheating. The study examines two blocks at the Kidbrooke Village Project that were identical in their orientation, layout and use, giving an opportunity to analyse, mitigate and advise on how to resolve overheating.

The blocks provide perfect conditions to monitor and compare the levels of internal temperature, relative humidity and external temperature over a 12-month period. An initial survey by Berkeley Homes attributed overheating to lighting gains and heat-loss transfer from the low temperature hot-water pipe network. Colt International designed a solution to address this. One block had a Colt CoolShaft evaporative cooling system installed to provide pre-cooling of air supplied to the corridors, while the other had environmental fans for the

## PRODUCT NEWS

### Kelvion announces NP150X plate heat exchanger

Manufacturer Kelvion has launched the NP150X plate heat exchanger, which has a very shallow plate gap and small pitch in the design to ensure highly turbulent flow and good transfer at very small temperature differences.

The OptiWave design enhances this effect by providing a highly uniform flow across the entire plate width, says Kelvion, which claims the heat exchanger plate achieved higher NTU values than the sister models of the NT and NX series.

It is suited to high-rise building cold supply, or data centre cooling, where gasketed plate heat exchangers for these applications require peak performance of heat transfer while withstanding high system pressure.

The Kelvion NP150X is available in plate material 1.401 and 1.4404 (US: AISI304 and AISI316L), and in thicknesses of 0.4, 0.5 and 0.6mm. It is suitable for a test pressure up to 42 barg.



### Mitsubishi Electric adds to chiller range and expands Mr Slim

Mitsubishi Electric has added to its range of Climaveneta chillers. The i-NX air-cooled chiller has standard and low-noise options, while the smaller i-BX air-cooled chiller is available in single and three-phase variants.

The new models use inverter-driven compressors, which Mitsubishi Electric says ensure maximum efficiency at part loads. Both chillers are ErP-compliant up to 2021.

The i-NX low-noise version delivers a reduction up to 7dBA over standard models, while the i-BX range offers capacities from 4kW to 35kW.

Mitsubishi Electric has also added R32 Standard Inverter and Inverter models to its Mr Slim split-system air conditioning range.

The Standard Inverter outdoor unit is available from 2.5kW to 14kW and includes extended pipe runs on larger models. It can connect to a range of indoor units, including ceiling cassette, concealed, and suspended, and wall-mounted models.

The Inverter outdoor units are available from 7.1kW to 14kW as ceiling cassette systems. Their Replace Technology means installers can move to the new systems while maintaining existing pipework.

### Trio on offer from Trane

Trane has introduced three compact chillers and heat pumps to its City range, which is part of the Ingersoll Rand EcoWise portfolio of products. The City Comfort, Process and Booster use R-1234ze refrigerant, and are designed to heat and cool small commercial buildings, industrial facilities and industrial processes. According to the company, they are 38% more efficient at part-load than the 2021 Ecodesign requirements.

The Comfort is a chiller for office buildings, hospitality, district cooling and heating, and data centres, and can be used in small industrial processes – such as food and beverage – and small agricultural production, including wineries.

Process offers highly efficient process cooling for food and beverage, warehouses, cold storage and ice rinks, and can freeze down to -12°C. Booster is a water-to-water heat pump and delivers hot water between 50°C and 80°C. It is designed for applications such as high-temperature heating, sanitary hot-water supplies, district heating and heat-recovery cascades.



supply and extraction of air to the corridors. This revealed a 4°C lower temperature in the former, demonstrating the economical, low energy use and high cooling capacity capability of the solution.

**'Assessing dehumidification in typical housing built to the Passivhaus standard in Jakarta, Indonesia – analysis for a hot, humid tropical season'**

– Roy Sigalingging, University of Liverpool

This study was to determine whether energy-saving modifications to urban houses in Jakarta through the application of Passivhaus principles are an effective cooling strategy in a hot and humid climate.

With a hot and humid climate region, the air's moisture level is high. Properly designed ventilation in a house will provide enough fresh air to keep the occupants healthy, remove odours and dilute pollutants. However, ventilation in hot weather introduces more moisture, which tends to raise rather than lower the indoor relative humidity.

About 30-50% of the energy used for air conditioning for cooling is also lost through ventilation and air infiltration. The paper investigates the effects on indoor temperature and humidity on comfort and energy use by gradually improving insulation levels and airtightness to the Passivhaus standard. The objective is to find the optimum setting for minimising cooling and dehumidification energy in air conditioning and

to achieve the lowest possible carbon emissions while maintaining a comfortable and healthy environment at an affordable cost.

**'Frese Delta T Control System perfecting return water temperatures in water-distribution systems'**

– Stephen Hart, Frese Ltd Affiliate

The basis of this project was to discover the importance of achieving design temperature difference ( $\Delta T$ ), which is critical for system efficiency and for plantroom performance. During the investigation at the Technical University of Denmark in Kongens Lyngby, it was identified that although the district cooling system has a design  $\Delta T$  of 6°C, many buildings were running with an actual  $\Delta T$  of between 1°C and 3°C.

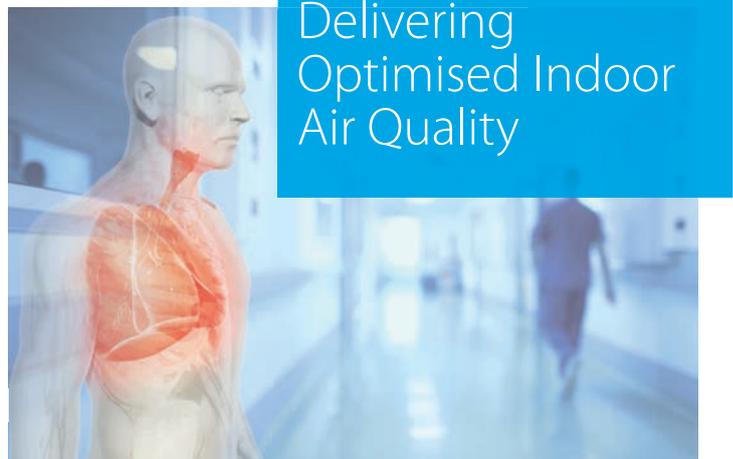
When the water flow through a terminal unit exceeds the design flow and the energy from the water cannot be efficiently transferred to the building, the power saturation point of the coil is exceeded, and the  $\Delta T$  drops below the design value for that terminal unit. Overflowing the coil consumes extra pump energy and lowers the efficiency of chillers, boilers and renewable energy schemes. Coils perform most efficiently when the  $\Delta T$  between the flow and return water to and from the coil is at the manufacturer's design  $\Delta T$  of the coil. In the study, when a selected coil was fitted with a Frese Delta T Control System, the pump energy consumed was 77% lower.



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# A SPRING IN THEIR STEP

An ambitious project is under way to replace Bath Abbey's 150-year-old heating system with low-energy underfloor heating, using heat recovered from hot springs rising in the nearby Roman Baths. BuroHappold Engineering's **Neil Francis** describes the challenges encountered at the Unesco World Heritage city site

**P**eople have used Bath's thermal springs for at least 2,000 years, with the city's Roman Baths topped up with 1.2 million litres of hot water flowing daily from hot springs. Since the 1980s, however, bathing has not been permitted and the majority of the hot water has, literally, gone down the drain.

This is set to change over the next 12 months, when the neighbouring 16th-century Bath Abbey starts employing hot spring water to provide heat for its 420,000 annual visitors and 600-strong congregation.

The Roman Great Drain, carrying 45°C spring water from the baths to the River Avon, passes close to Bath Abbey. The plan is to capture energy from the hot water in the drain, using heat exchangers, before boosting the temperature with heat pumps located in an expanded plantroom in a basement vault within the Abbey.

An urgent need to replace the ancient building's precarious flooring created the opportunity to install underfloor heating. More than 8,500 burials have significantly weakened the floor structure, so – in 2010 – the Abbey launched its Footprint Project to repair it, install a low energy heating system and create new meeting, catering and

toilet facilities. There will also be a Discovery Centre, telling the story of the Abbey.

Existing heating was also at the end of its useful life. Cast-iron pipework and gratings are more than 150 years old, and there were comfort issues caused by excessive cold draught from the huge areas of glazing in the Abbey (see diagram, top right).

Early design-stage studies quickly identified underfloor heating as the preferred background heating solution,

## PROJECT TEAM

**Client:** Bath Abbey  
**Architect:** Feilden Clegg Bradley  
**Building services engineer and sustainability services:** BuroHappold Engineering  
**Heat pump specialist:** Isoenergy

with supplemental trench heating for colder days.

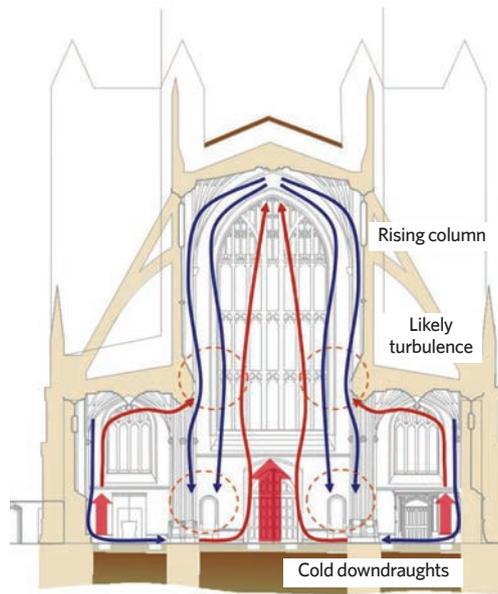
Underfloor heating is ideal for connecting to 'low grade' alternative energy sources; it's able to operate efficiently at lower temperatures and would provide beneficial radiant heating to the low-level occupied zone in the large-volume Abbey space.

**The heating strategy**

Dynamic thermal modelling and computational fluid dynamic studies of the whole Abbey space allowed the design to be refined – particularly, confirming the nave trench-heating realignment from directly below the side windows to the centre, to reduce large-scale convective currents. The air velocity of the new design will be much lower and the radiant heating will be uniform.

The coordination of the underfloor heating build-up and trenches was necessary because of the layers of burials and archaeology, which have formed over time. The heating design has had to be refined during construction as new discoveries are made.

It is envisaged that the underfloor heating will be on 24 hours a day from October to March. The restored flooring will be covered with the original 6in-thick ledger stones (inscribed slabs marking burials) laid over the screed, which means it will have a large mass to hold heat.



A cross-section of Bath Abbey prior to current construction works, showing the large-scale air circulation in the winter caused by warm air rising from heat trenches and cold air falling from windows

**The Great Drain**

While the spring water is great for bathing, it is difficult to use technically because of its high mineral and silt content, dissolved oxygen and risks of corrosion, as well as health risks from 'pathogenic amoeba'. So it was decided to opt for a closed-loop heat exchanger, whereby the heat is transferred from the hot spring water to a closed water loop via heat exchangers placed in the flow of

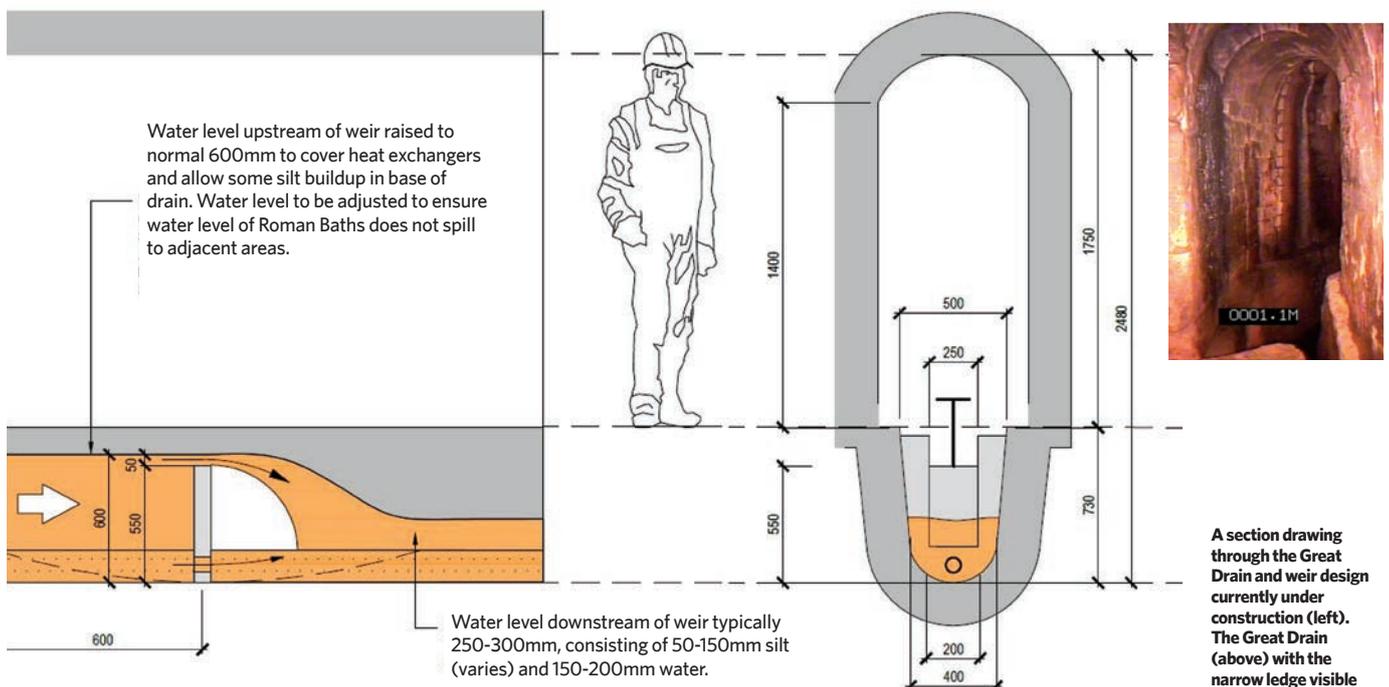
a Roman drain. This carries spring water at 14 litres per second from its source at the Roman baths to the River Avon.

The closed-loop solution will use energy-blade stainless steel heat exchangers, submerged in pairs in series along the length of the drain, to extract 160kW of energy.

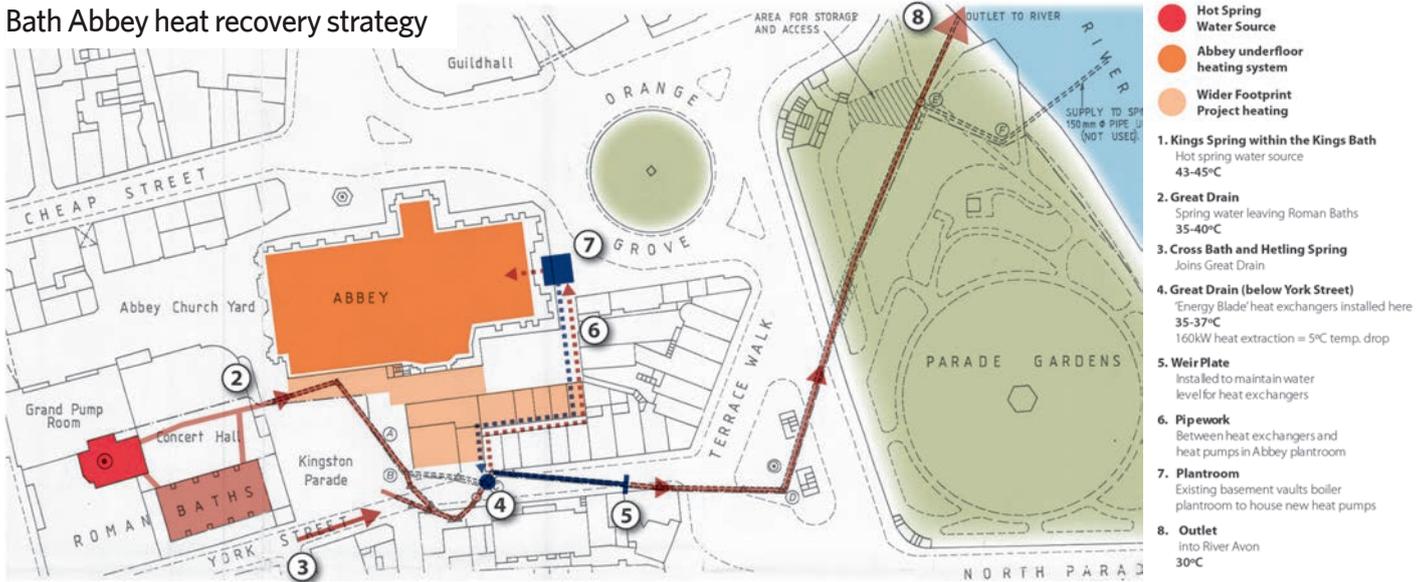
The heat exchangers will supply water at the 25°C required by the Abbey electric heat pumps, which will raise the temperature to 50-55°C. This is suitable for underfloor heating in the heating season and trench heating during milder weather. Conventional gas-fired boilers will supply water to the trenches at 80-85°C during cold weather, and offer back-up to the heat recovery system.

Numerous trials, investigations and mock-ups have been carried out in the Great Drain. Any works are a challenge because of approvals, difficult access, confined space, and a high temperature and humidity environment. Before access, the drain has to be vented to the atmosphere to release any build-up of heat, humidity and gas.

One important consideration is that the water flow in the Great Drain is only 150-200mm deep. So a key series of investigations >>



Bath Abbey heat recovery strategy



Map showing the course of the Great Drain and the position of the energy blades where energy will be recovered from the hot spring water



A similar heat recovery system at the Roman Baths must not reduce the visible steam

**“The drain is 7m below street level and difficult to access, so engineers must have had confined-space training”**

» during the design stage involved the study of water flows and temperature; the installation of a mock-up pair of heat exchangers; and the installation of a mock-up weir to raise the water level in the drain sufficiently to submerge the heat exchangers while not flooding the upstream Roman Baths. Testing was done in the winter, when river levels were high. The river backed up the drain, and there was some dilution of the hot spring water in the drain, but without impact on the energy blades.

Because of the amount of silt in the spring water, the weir had to be designed to avoid the build-up of mud, and the final design allows for both overflow and underflow.

The site chosen for the energy blades was in a straight section of drain, around 1.8m high, that offers access via York Street. The drain at this point has a raised walkway ledge running above the flow of the water (see image on page 47), but because the drain is 7m below street level and difficult to access, maintenance engineers must have confined-space training and be lowered by tripod into the drain.

At this point, the temperature of the water is 35-37°C and the extraction of the heat will cause it to drop by 5°C. The water is calculated to enter the Avon at 30°C (see map, above).

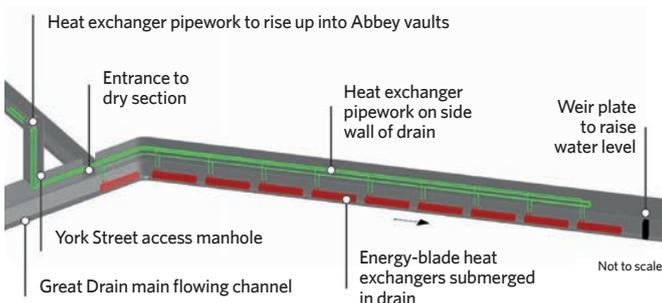
The pipework and fixings installed in the drain connecting up the energy blades will be in reverse return arrangement and will be made from stainless steel to prevent corrosion. Fixings must be kept to a minimum to avoid damaging the Georgian walls in the drain, and the pipework – while following the contours of the drain – must not protrude so far that it stops engineers from accessing the ledge running alongside the water.

The project design started in earnest in 2010, and on site in summer 2018, and should be completed in 2020. Heat-recovery works in the drain should begin early this year, with heat recovery starting later in 2019 to allow for commissioning and fine-tuning.

Calculations for heat recovery from the Great Drain took into account the fact that a similar system – also being worked on by BuroHappold – is being designed for the Roman Baths. The challenges are similar to the Abbey project, but with the added requirement that the steaming effect in the hot bath is not lost when heat is recovered from the spring.

It is calculated that taking out 80kW of heat will supply buildings at the Roman Baths with background heating at night and some mid-season heating, while having a negligible visible effect on Bath’s world-famous steaming baths.

Great Drain and heat exchanger



Ten pairs of energy blades will recover heat from the drain in closed loop

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# HEAT GAIN

A major update to the Heat Networks Code of Practice includes key performance outputs that allow clients to check their networks are performing as designed. Here, the authors highlight the major revisions, including minimum requirements and more emphasis on low return temperatures

**W**e have spent much of 2018 working on an update to CPI CIBSE/ADE Heat Networks Code of Practice and the revised draft is now out for public comment. This draft is also the result of considerable work by a wide-ranging steering group and other experts in the sector, for which we are very grateful.

CPI.2 is a significant update to the 2015 version, CPI, which has been highly successful in establishing minimum standards to improve the quality of district heating projects. CPI has also started to have a strong influence on the procurement of heat networks and underpins much of the work by the Department for Business, Energy and Industrial Strategy (BEIS).

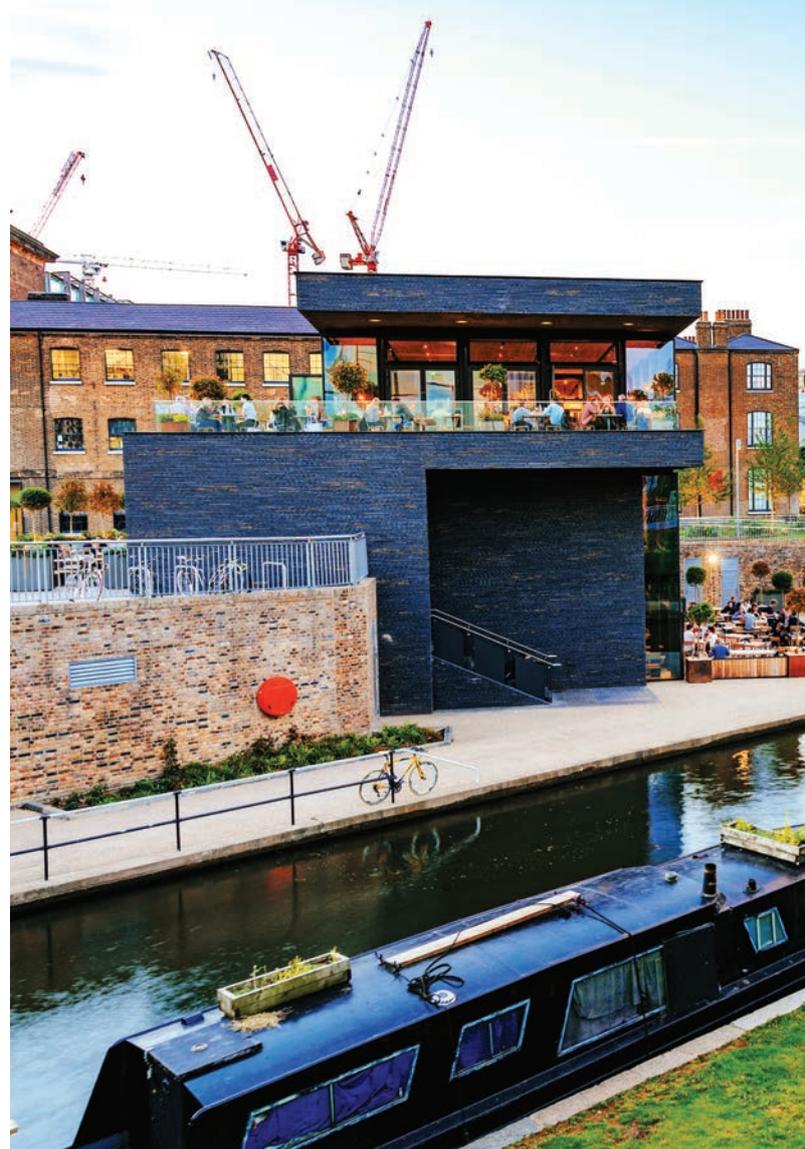
It was always recognised, however, that the code would need to be updated at intervals to reflect new experience, understanding and feedback from the sector. Probably the most important update has been to make compliance with CPI.2 easier to verify and check. It is our ambition that this code will contribute to the future regulation and decarbonisation of the heat sector.

## So what's new?

The overall structure of the code remains the same, but several objectives have been added. There are also a lot of new minimum requirements, with some previous best practice becoming minimum requirements.

The key themes around delivering efficient, cost-effective and low carbon heat to customers remain broadly the same, but with more focus on achieving customer satisfaction. They include correct sizing, achieving low heat losses, low return temperatures and optimising the use of low carbon heat sources to provide affordable heat and a reliable service.

Client briefing has been strengthened significantly to ensure the right questions are asked and appropriate targets set at the beginning of projects. It focuses particularly on outcomes, the sort of system they are trying to achieve, and customer satisfaction.

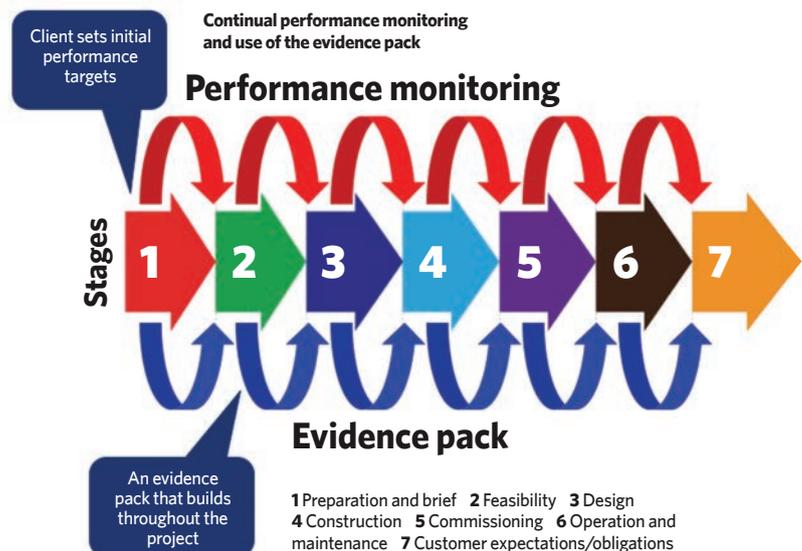


## Compliance and performance

The existence of the code begs the question: 'How does the client check that it has been met?' CPI.2 includes a series of key outputs in each of the objectives and these are used as checks to demonstrate compliance.

Code checklists allow clients to assess – on a stage-by-stage basis – that outputs have been produced and expected performance met. They are signed-off by the lead designer/contractor and the client, and this approach helps build an evidence pack across all stages of development, to help integrate the supply chain.

The checklists include performance measurement throughout the development process, by clients setting initial targets and monitoring against these at each stage, including in operation. Audits, checklists, an evidence pack and performance measurement should result in better



### The King's Cross estate has a heat network



heat networks and greater confidence for developers and investors.

### Diversity

Heat network sizing – for example, pipes, heat exchangers, pumps and so on – is underpinned by diversity of use. CP1 was based on DS 439 Danish Standard, but a number of sources of diversity data are included in CP1.2, which may be used to estimate peak demands.

CP1.2 recommends using diversity based on BS EN 806, but allows the designer to use other, fairly similar, diversity curves or their own measured data sets. Guidance on including space-heating diversity has also been added.

### Heat interface units (HIUs)

A fundamental design choice is whether to connect buildings directly to the heat network, or indirectly, where a heat exchanger provides a physical barrier to the water. Both connections have been used in UK schemes, with indirect ones more prevalent. CP1.2 now references

the recently updated BESA Test Regime Technical Specification which covers a range of types and duty's of HIUs for dwellings.

Oversizing HIUs is an increasing problem, so CP1.2 gives typical upper limits on the size of HIU plate heat exchangers to avoid oversized pipework. Based on work by Huw Blackwell, HIUs should be less than 45kW for a typical three-bed property and less than 25-30kW for a one-bed flat, unless there are exceptional circumstances.

### Bypasses

There is now greater emphasis on achieving low return temperatures, often the key to well-performing heat networks. One of the main problems is still around water bypassing back to the energy centre without contributing to heat consumption. As a result, CP1.2 has tighter requirements to avoid bypasses where possible.

The use of keep-warm bypasses should be avoided but, where they are necessary, the bypass flowrate should be minimised. Lowest losses will be achieved by using pipe layouts that allow HIUs without a keep-warm function still to deliver domestic hot water rapidly. It is also essential that flushing bypasses do not remain open after flushing, so – preferably – use temporary ones that can be disconnected after use.

### Heat losses

Primary network insulation levels have been strengthened; in most cases, the calculated total annual heat loss from the primary network should be less than 10%. Designers must justify losses greater than 10% and the total primary network heat losses should not be more than 20% of the heat supplied by the energy centre.

Probably the greatest improvement has been to set standards on heat losses from HIUs and internal (secondary) pipework. The total annual loss from the secondary pipework distribution and other equipment within the building should be less than 876 kWh/dwelling/year – equivalent to an average continuous loss of 100W.

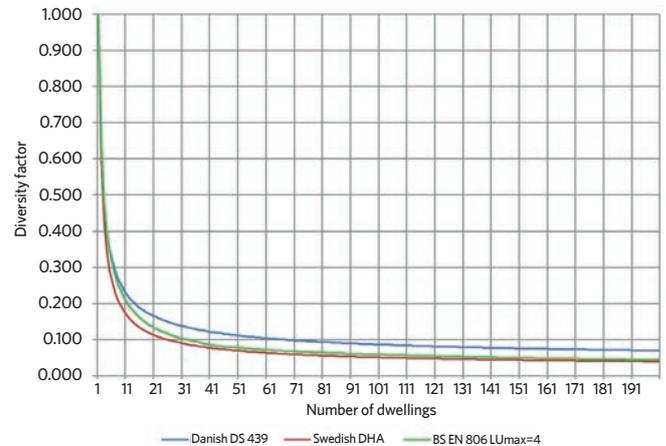
### Acceptance testing

Even plant that has been formally commissioned can fail to deliver an efficient, reliable service to the heat customer. Unfortunately, formal

## PUBLIC CONSULTATION

Version 7 of CP1.2 and compliance checklists are available for public comment at [bit.ly/2Mp1hhM](https://bit.ly/2Mp1hhM)

Any proposed changes should be supported by evidence in the feedback form. Comments should be sent to [CIBSECoP1revision@cibse.org](mailto:CIBSECoP1revision@cibse.org)  
This public consultation will close on 10 February 2019.



A number of sources of diversity data are included in CP1.2 to help estimate peak demands

commissioning commonly focuses on simply testing that equipment 'actually works' when turned on – and this is often a single item of equipment in isolation, without reflecting overall network performance.

CP1.2 requires a series of onsite 'acceptance' tests to ensure the system meets the required performance standards and that the customer receives the promised service. Without adequate acceptance testing, faults will only emerge during the early years of operation, and then be more expensive and disruptive to resolve.

### Other changes

There are new objectives on working with legal/financial experts to identify investability, risk and procurement routes. Pipe sizing, controls, commissioning, and optimisation of thermal storage are all now much more rigorous, with clearer requirements, and the different parts of a heat network have been more clearly defined.

Metering, automatic meter reading (AMR), data collection and billing are far more prominent and there is much greater emphasis on granular data, at feasibility and design right through to monitoring operation. Requirements around water quality have also been strengthened, with more about flushing, filling, dosing and filtration to ensure the long-term life of the network asset.

### Your feedback

CP1.2 is a major update to the code, with a lot of changes to improve the quality of heat networks. This second edition remains a work in progress, however, and more needs to be done to establish a detailed evidence base. Nevertheless, CP1.2 is a very significant step forward and aims to take the heat network sector to the next level. **CJ**

**PHIL JONES**, energy consultant, Building Energy Solutions  
**PAUL WOODS**, district heating consultant  
**MARTIN CRANE**, consultant, FairHeat

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# Other factors

Lower carbon factors for grid electricity, in draft SAP 10, will profoundly affect how designers provide heat and power to buildings. Remeha's general manager, Mike Hefford, puts the case for monthly intensity calculations

There has been lively industry discussion about the Government Standard Assessment Procedure (SAP) and proposed changes to the methodology – but why the widespread interest? The purpose of SAP is to calculate regulated energy and associated carbon emissions in domestic buildings. However, some aspects are referenced by the Simplified Building Energy Model (SBEM), so the updates affect the commercial sector and non-domestic buildings.



**“Given the variation of the generation mix it is unworkable to keep using an annual average methodology”**

In July 2018, BRE released – for information and feedback – a preliminary version of SAP 10 (V10.0) that comprised relatively minor convention updates and, more importantly, a revised carbon intensity value for grid-supplied electricity. There were also updates to heat network distribution loss factors.

The proposed changes sparked concern among stakeholders: first, that the updates could reduce the viability of heat networks, in conflict with the stated aims of the government's Clean Growth Strategy; and, second, that significantly diminishing the value of embedded generation at building level would reduce investment and innovation in product development.

It's clear the grid carbon value for electricity in SAP 2012 (V9.92), currently in use for Building Regulations compliance, is out of date. But is a 55% reduction to 233gCO<sub>2</sub>/kWh, and the use of an annual average methodology, an appropriate reflection of reality, especially when applied to seasonal loads such as space heating?

Looking at the Digest of UK Energy Statistics (Dukes), it's evident that the fall in grid carbon intensity is attributable to the rapid reduction of coal-powered generation, which has largely been squeezed out of the mix by additional gas capacity and renewables (Figure 1). This downward trajectory will continue but, given the seasonal and even inter-day, variation of the generation mix – and the uncontrolled, intermittent nature of renewables – it is unworkable to continue using an annual average methodology in SAP.

If we take monthly grid carbon intensity figures from the past four years, a distinct seasonal pattern emerges (see Figure 2). Note, also, that the proposed SAP 10 annual average value is significantly lower than the greenest summer months on record of 2017. Why is this important? For technologies that only operate at certain times of the year – heating in the winter, cooling in the summer – an

annual average value will over- or under-represent the actual carbon intensity at the time of use.

Furthermore, embedded generation technologies, which offer significant wider benefits to local grid balancing, peak-demand reduction and grid resilience, are not modelled accurately. Consequently, they may be dropped down the specification pecking order when seeking compliance with Building Regulations Approved Document L.

Surely a monthly evaluation and determination of the carbon content of building services is more appropriate, accurate and transparent for all technologies? Within SAP and SBEM, space heating and hot-water provision are already calculated on a monthly basis, so – from a methodology perspective – carbon or primary energy could easily be calculated in this way.

It is essential to bear in mind that SAP 10 has been published for information only and may change before implementation. The Department for Business, Energy and Industrial Strategy has confirmed that SAP 2012 must be used for Building

Regulations compliance until any Part L consultation changes are known and an approved SAP is made available. A government consultation on this matter is expected >>

**MIKE HEFFORD**  
is Remeha CHP's  
general manager

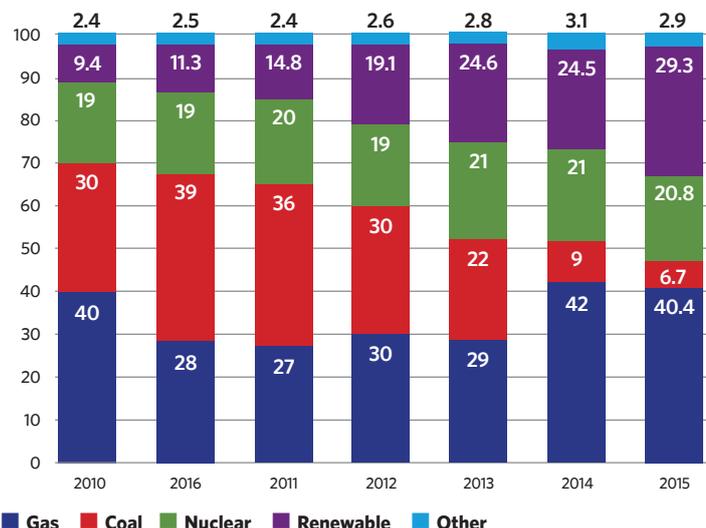


Figure 1: UK power generation mix 2011-2017 – Source: Dukes  
[www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes](http://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes)

» this year. In light of this, the Greater London Authority's decision to allow new development applications from January 2019 to use the annual average carbon values is surprising and, perhaps, somewhat premature.

Approved Document L may undergo future revision, so it's also worth considering the EU Energy Performance of Buildings Directive (EPBD). This requires the energy performance of a building to be expressed by a numeric indicator of primary energy use in kWh/(m<sup>2</sup>-y) for both energy performance certification and compliance with minimum energy performance requirements. In other words, the building compliance metric is expected to shift from carbon emissions to primary energy use. While this alters the outcomes on a technology basis slightly, the argument of seasonal variation in grid intensity still applies.

The proposed grid primary energy factor (PEF) in SAP 10 is 1.738, down from the 3.07 figure used today – and, again, it appears slightly optimistic. Interestingly, there has been a prolonged debate between the EU Commission and EU Council about the appropriate PEF to apply across other directives, such as the Energy Efficiency Directive and EcoDesign. The figure in the pipeline is a reduction from 2.5 to perhaps 2.1. Can we seriously suggest that the UK generation mix during the life-cycle of SAP 10 will be significantly cleaner than other member states?

Until the inter-seasonal storage of low carbon electricity generation is a reality, it's imperative the changing

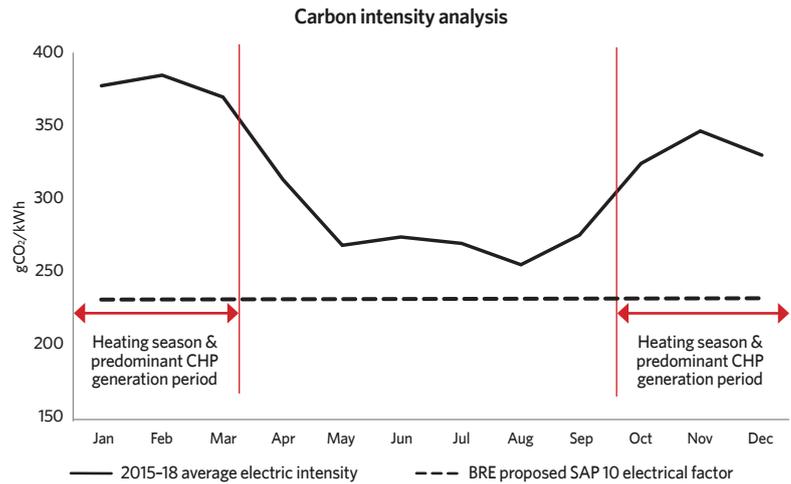


Figure 2: Seasonal carbon intensity analysis Source: internal analysis and electricityinfo.org/fuel-mix-archive/#data

generation mix throughout the year is reflected in national calculation models that avoid misrepresentation of actual energy and emissions use. Indeed, deeper granularity may be necessary for future smart-grid applications and time-of-use tariffs – down, perhaps, to half-hourly values.

Robust, validated data is available to support monthly values, so SAP 10 could be amended to a more realistic and representative model.

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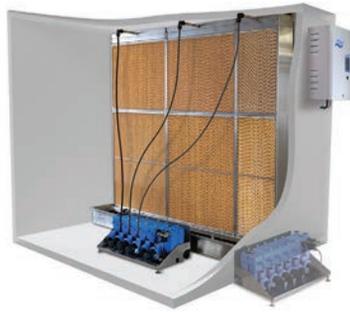
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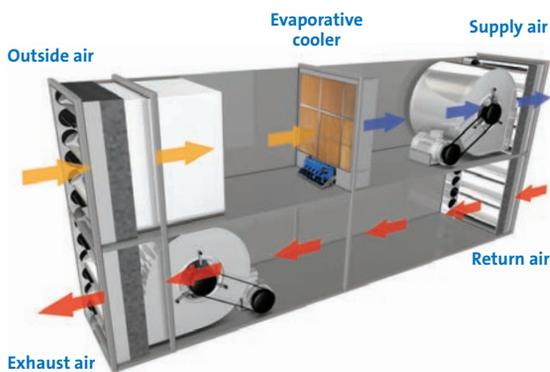
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# STANDARD APPROACH

Rigorous testing of manufacturers' heat interface units means heat networks are much more likely to perform, so minimising fuel bills. **Ewen Rose** looks at the latest developments in the BESA HIU testing regime, which is gaining traction in the UK

**T**he UK's first test regime for heat interface units (HIUs), being managed by the Building Engineering Services Association (BESA), has been revised and updated in response to growing demand from the district heating industry. Two UK-based test houses – BSRIA and Enertek International – have been approved to carry out testing, in addition to the Research Institutes of Sweden (RISE), which was the only organisation previously able to test to the new UK standard.

HIUs extract heat from district heating networks to feed individual buildings and dwellings. How they perform is central to the overall efficiency of a district scheme, so the test regime was set up to help developers of UK heat networks to procure HIUs based on comparative performance data.

The availability of a UK test regime has prompted considerable response from manufacturers with a large number of units already tested at RISE and several more going through the process at BSRIA and Enertek.

Testing to the BESA standard is a two-stage process; the HIU has to achieve a UKAS or equivalent national accreditation through one of the three test houses; this result must then be verified by the Standard's Steering Group before being published on the BESA Online Register ([www.theBESA.com/ukhiu](http://www.theBESA.com/ukhiu)).

## Performance

The test regime emerged from a heat network efficiency research project supported by the Department for Business, Energy and Industrial Strategy. Testing to the BESA standard is helping to create a comprehensive product database and improve performance of UK heat networks.

Modelled on a well-established Swedish methodology, which was adapted to suit typical UK operating conditions, it allows products and equipment types to be



compared, so that network designers can evaluate the performance of individual HIUs against their design parameters.

The BESA test regime was explicitly developed to support the most commonly used HIUs in the UK. It assesses their performance when deployed in new-build developments and under typical operating conditions for radiator and underfloor heating systems.

The test calculates the annual volume weighted return temperature (VWART) and provides evidence of compliance with other performance and reliability metrics, such as

**“The BESA HIU Online Register is rapidly becoming the default point of reference for those making procurement decisions”**

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The BESA test regime supports the most commonly used HIUs in the UK

demand in most modern apartments, so only a very small flow rate is required on the heating circuit. This rate can make it difficult to balance the radiators and, therefore, the return temperature is too high – which undermines the efficiency of the whole network.

One solution developed by several manufacturers is the use of return temperature limitation (RTL), which means a maximum return temperature to the network is set when the HIU is installed. This protects the network from poor performance and potential failure caused by and high primary flow rates.

There has also been a problem with some HIUs having a permanent pre-heat function that ensures heat is drawn through the unit 24 hours a day.

This can be wasteful, as well as expensive for the end user, but many units now allow the pre-heat function to be reset, so it only works when required and not continually.



Network designers can now evaluate and compare HIUs

domestic hot water response time. Heat and hot-water loads are tested based on new-build developments with apartments or small to mid-sized houses, with a maximum output below 70kW. Indirect HIUs, with hydraulic separation for instantaneous hot-water production and space heating provided via two, separate plate heat exchangers, are also covered by the process.

The test regime and the basis of the VWART calculation are most representative of HIU operation in new-build flats. However, the VWART calculation can be modified to better represent HIU performance in larger properties with higher hot-water demands and/or heating loads.

The BESA standard is already contributing valuable information and data to the industry's wider efforts to address performance problems across heat networks, including how systems are controlled and demand managed. For example, improved insulation standards have created low heating

### Expanded

As part of the revision process to clarify the test regime for the BESA Standard, the HIU Steering Group was expanded and a technical sub-committee – comprising industry experts and the three test houses – set up. Several positions in the group have been made available to HIU manufacturers exclusively, so they can help with the development of the regime. This is designed to ensure all stakeholders across the sector are represented – from developers, specifiers and purchasers, through to manufacturers, installers/suppliers and, ultimately, the end user.

This group will soon start making recommendations to the steering group on developing the standard, including a planned expansion of the test regime. An HIU Manufacturers' forum has also been established. This has regular meetings at BESA's headquarters in London and gives valuable feedback to the steering group.

'One of the standard's great strengths is that it has been developed by users, for users,' said UK HIU Steering Group chair Gareth Jones. 'It provides them with a clear basis on which to evaluate HIU performance, and the BESA HIU Online Register is rapidly becoming the default point of reference for those making procurement decisions within the industry.'

'As a result, HIU manufacturers must now ensure their units perform well, and we are seeing a significant increase in research and development. Ultimately, this raising of standards will help improve the health of the heat network industry as a whole.' CJ

■ For more information visit: [www.thebesa.com/ukhiu](http://www.thebesa.com/ukhiu)



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# Budding into life

The Construction Youth Trust aims to give those from marginalised sectors of society the opportunity to grow a career in the building sector. **David Blackman** finds out how the charity is helping young people fulfill their potential with initiatives such as Budding Builders

**T**he UK's major cities contain some of the country's most entrenched areas of poverty, many of which sit cheek by jowl with its biggest-ticket construction projects. Matching young people from these disadvantaged neighbourhoods with the opportunities on their doorsteps is the mission of the Construction Youth Trust (CYT), which was set up by the industry in 1961.

Currently, the CYT works mainly in London, north Kent and the Midlands, which contain sufficiently large workflows to create opportunities for potential candidates, says Andrew Garrett, the charity's operations manager. 'These are areas where there is disadvantage, but also the prospect of a real job at the other end,' he adds.

One of the main ways the trust tries to help young people is by going into schools, often with representatives from the charity's industry partners, such as contractor Multiplex, which has been involved with the CYT for several years.

The trust's schools partnership programme organises activities designed to engage students and get them involved in construction. These include 'Budding Builders', which is targeted at young people at risk of becoming 'Needs' – not in education, employment or training.

The proportion of pupils who receive free meals is the gauge used to identify which schools might be most in need of the trust's work. These schools then identify pupils who are in danger of becoming Needs.





'It's not about us working in isolation with the young person, but working with the schools,' says Deavon Sinclair, CYT's schools and further education coordinator.

Another programme, Budding Brunels, is aimed at sixth-formers who are looking to enter built environment professions such as quantity surveying and engineering.

The three-day scheme showcases the diverse professional opportunities on offer in the construction industry. It also covers interview and public speaking skills, so that the young people are better equipped when applying for university courses and apprenticeships.

Separate from its schools activities, the CYT runs an apprenticeship support programme, backed by funding from the Construction Industry Training Board. It works predominantly with 17 and 18-year-old students looking to take higher level or degree apprenticeships.

At the apprenticeship support sessions, employers show would-be candidates what they are looking for in terms of responses on application forms. The trust also takes students out of their school environment to expose them to construction sites or project offices.

Sinclair believes it is important for participants to get a good understanding of what different roles in the industry entail. 'If it's a building services engineer, they get a site tour, so they can see the work that takes place and understand how the subjects they are studying in class - such as maths and physics - translate into a working environment,' he says. 'Depending

## "Everyone thinks it's just men in hard hats doing dirty jobs. Challenging perceptions about the industry is vital"

on how students perform, some will be put forward for workplace opportunities.'

Candidates are pre-screened to ensure they are ready for a placement, so both they and the construction firm benefit from the experience, says Garrett. Such an opportunity can give the would-be apprentice a better sense of the tasks and responsibilities relevant to their area of interest, reducing the risk that they will drop out from the apprenticeship.

Nick Wicks, community engagement manager at Multiplex, says the CYT's programmes can raise pupils' aspirations by showing how construction offers the potential to make a good living. 'You can start as a labourer and work up to be a project director; if you have the drive and capability that will be seen,' he says, referring to how one of Multiplex's most senior managers started his career as a joinery apprentice at the age of 16.

'He's now in charge of £200m jobs. There are very few industries where real talent is identified and rewarded.'

Wicks is particularly keen to show young people the range of routes into the industry, including professional roles in building services. 'I want to get people out of the mindset that it's all about trudging around in the mud for the rest of your life: you can aspire to rise up,' he says. 'It's important to address misconceptions that construction is purely "on site".'

Multiplex and the CYT recently held an event for year 10 and 11 pupils from schools in the London borough of Westminster. 'We talk about different careers and get the kids to think outside the box about the wonderful opportunities in construction,' says Wicks, who adds that consulting and engineering firms are a closed book for most students. 'Everyone thinks it's just men in hard hats doing dirty jobs. Challenging perceptions about the industry is vital.'

He cites building controls installation as one of the more technologically sophisticated roles in the industry. 'When [the students] see some of the



Students get the chance to experience augmented reality on a CYT programme



The trust shows young people the opportunities within construction

“The construction industry is not one that worries where you come from if you are doing a good job. It’s very tolerant and inclusive”



Chase Farm Hospital, Enfield, on which Shane Sullivan (below) worked

» high-end systems and the blinds and windows they can control from an app on their phone or tablet, it’s an eye-opening experience,’ Wicks says.

Building information modelling (BIM) is also ‘pretty exciting’ for today’s tech-savvy youngsters, he adds. ‘You can demonstrate how you can design a system and work out where every cable and pipe is going to run.’

The other big plus point for construction is that it is more prepared than some industries to offer a second chance to young people who may have messed up, Wicks says:

‘The construction industry is quite forgiving if people have made mistakes in the past.’

Garrett agrees: ‘The industry is really tolerant of backgrounds: it’s not one that worries where you come from if you are good at the job. Your progress is very much around the next job: it’s an inclusive industry and doesn’t have the elitism some have.’

Of course, the trust’s work in seeking to expand the industry’s talent pool is also in the industry’s interests. ‘The supply of trades is drying up, when you ask senior managers where the gaps are, they say everywhere,’ says Wicks.

Many councils are making developers offer apprenticeships as a condition of planning consent. And, while the CYT’s work with young people doesn’t always pan out successfully – which is unsurprising given the challenging backgrounds from which they come – the rewards are great, says Sinclair.

He recalls one group of Year 12s who were not ready for apprenticeships when they began working with the trust, but – by the end – most of them were: ‘The best thing is seeing that change and development in young people over time.’ 

### SPARKING A LOVE FOR LEARNING



Shane Sullivan was the kind of boy who couldn’t wait to get out of school. ‘I hated being in the classroom,’ he says. ‘I enjoy learning, but hate people telling me what to do. As soon as I could, I wanted to get out of there.’

Now, however, the 22-year-old is studying for a degree apprenticeship in electrical engineering at London South Bank University.

He credits a course with the Construction Youth Trust in 2013, when he was a bored Year 10 student at his comprehensive school in Dagenham, with setting him on this path.

It showed him opportunities in the construction industry that he would otherwise not have stumbled across. ‘[The CYT] opened your eyes to different things. School pigeon-holed you; [the CYT] didn’t, but showed you different things, such as surveying and engineering.’

After leaving school, Sullivan did a City & Guilds course in construction trades and another in electrician skills. He then secured an apprenticeship in electrical engineering with building services engineer Troup Bywaters + Anders.

He started off by studying for a BTech, but is now in the middle of a degree apprenticeship. The blend of work and study suits the way he learns, as well as his bank balance. ‘I can earn when I’m doing the job and don’t have to pay for the university course,’ Sullivan says.

‘I can have a joke with the teachers and go at my own pace: I don’t have to sit at the same table and chair every week.’

Sullivan is mainly working on healthcare projects, which range in size from GP surgeries to the recently completed Chase Farm Hospital in Enfield.

Would he have imagined fulfilling a professional role on such a big project when he was a bored pupil? ‘Definitely not – not in a million years.’



Chase Farm Hospital



# Bridge over troubled water

Uncertainty over Brexit has not dented the confidence of the building services sector. Above-average pay rises and a continuing skills shortage mean adventurous engineers still have many opportunities to explore. **David Blackman** reports

**O**ptimism is running high in building services, despite the wider economic uncertainties surrounding Brexit. That's the key finding of the latest *CIBSE Journal* salary guide, compiled by Hays Building Services.

The recruitment consultancy's annual survey of building services employers shows that 97% expect business activity levels to increase or stay the same over the next 12 months. While this is marginally lower than the unanimous confidence expressed this time last year, nearly two-thirds (61%) of firms are planning for increased activity. Nearly as many (59%) report optimism about the wider economic climate and the opportunities it may

create in the next two to five years – higher than the overall figure of 43% for UK employers.

The survey's findings are reflected at Black & White Engineering, which has its headquarters in the North East and has seen its turnover double compared with the previous year. Steven Horn, a director of the company, expects growth to be only 'slightly' slower this year.

David Stafford, director of S I Sealy, says the firm's pipeline of work will keep it 'very busy' for the next 12 months at least: 'We're busy fools at the moment – working our socks off.'

Peter Sutcliffe, managing director, buildings and places, for London Commercial at Aecom, says: 'We have been surprised by how much >>

The salary data has been compiled using information gathered during 2018 from Hays offices across the UK. It is based on job listings, job offers and candidate registrations. The recruiting trends are based on the survey findings of almost 23,000 employers and employees.

BREXIT UNCERTAINTY

» activity there is in the market.' Activity levels are very strong, he says, although the 'big question' is whether private sector clients will put projects on ice because of broader concerns about the market.

More than two-thirds (65%) of building services professionals would still consider moving jobs in the next 12 months, according to Hays. Uncertainties surrounding the wider economy could weigh on moves though, cautions Sutcliffe, who believes: 'If the market gets jittery, people will stay put.'

James Ford, who heads up Hoare Lea's sustainability team, agrees. 'There needs to be a level of confidence for candidates to move and for employers to recruit.'

Such concerns do not appear to be holding back the 80% of building services employers that, according to the survey, are planning to recruit over the next 12 months. More than a third (39%) plan on hiring temporary or



**"More than a third said skills shortages have had an effect on expansion – while 41% said they have undermined their companies' ability to deliver projects"**

**Contractors: Directors**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£57,500	£50,000	£73,000
London	£95,000	£80,000	£120,000
West Midlands	£61,000	£60,000	£70,000
East Midlands	£62,500	£60,000	£80,000
North West	£60,000	£60,000	£75,000
Northern Ireland	£67,000	£65,000	£85,000
Scotland	£55,000	£50,000	£65,000
South East	£75,000	£73,000	£80,000
South West	£60,000	£55,000	£65,000
Wales	£55,000	£55,000	£65,000
Yorkshire and the Humber	£54,000	£48,000	£62,000
North East	£58,000	£57,000	£62,000
National average	£63,333	£59,417	£75,167

% increase year on year: 3.5%

**Contractors: CAD technician**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£24,500	£22,000	£27,000
London	£41,500	£30,000	£50,000
West Midlands	£28,500	£25,000	£35,000
East Midlands	£28,500	£25,000	£30,000
North West	£29,000	£25,000	£32,000
Northern Ireland	£28,500	£24,000	£30,000
Scotland	£23,000	£22,000	£26,000
South East	£35,000	£33,000	£40,000
South West	£30,500	£30,000	£35,000
Wales	£29,000	£27,500	£32,500
Yorkshire and the Humber	£25,000	£23,000	£28,000
North East	£26,000	£23,000	£28,000
National average	£29,083	£25,792	£32,792

% increase year on year: 2.7%

**Contractors: Contract quantity surveyor**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£42,000	£33,000	£52,000
London	£58,500	£50,000	£80,000
West Midlands	£44,500	£45,000	£55,000
East Midlands	£43,000	£44,000	£55,000
North West	£39,500	£40,000	£55,000
Northern Ireland	£40,000	£35,000	£48,000
Scotland	£42,000	£35,000	£45,000
South East	£60,000	£55,000	£65,000
South West	£46,000	£45,000	£50,000
Wales	£43,000	£40,000	£45,000
Yorkshire and the Humber	£37,000	£32,000	£42,000
North East	£40,500	£35,000	£44,000
National average	£44,667	£40,750	£53,000

% increase year on year: 4.1%

**Contractors: Estimator**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£43,500	£35,000	£55,000
London	£56,000	£45,000	£60,000
West Midlands	£41,250	£40,000	£50,000
East Midlands	£41,500	£30,000	£45,000
North West	£41,000	£38,000	£45,000
Northern Ireland	£35,000	£32,000	£40,000
Scotland	£39,000	£35,000	£44,000
South East	£59,000	£45,000	£62,000
South West	£41,000	£40,000	£50,000
Wales	£38,500	£35,000	£45,000
Yorkshire and the Humber	£34,500	£26,000	£38,000
North East	£36,000	£31,000	£40,000
National average	£42,188	£36,000	£47,833

% increase year on year: 2.7%

**Contractors: Project engineer**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£38,500	£32,000	£48,000
London	£49,000	£40,000	£60,000
West Midlands	£38,000	£30,000	£45,000
East Midlands	£37,000	£25,000	£38,000
North West	£39,000	£30,000	£40,000
Northern Ireland	£34,000	£28,000	£36,000
Scotland	£38,500	£28,000	£40,000
South East	£42,500	£40,000	£45,000
South West	£37,000	£35,000	£42,500
Wales	£35,000	£30,000	£40,000
Yorkshire and the Humber	£34,000	£30,000	£42,000
North East	£33,500	£28,000	£37,000
National average	£38,000	£31,333	£42,792

% increase year on year: 3%

**Contractors: Project manager**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£47,000	£40,000	£57,000
London	£68,500	£60,000	£75,000
West Midlands	£46,000	£40,000	£55,000
East Midlands	£48,000	£35,000	£50,000
North West	£46,500	£30,000	£48,000
Northern Ireland	£37,000	£37,000	£45,000
Scotland	£43,500	£30,000	£45,000
South East	£65,000	£52,500	£67,000
South West	£46,000	£45,000	£52,500
Wales	£42,500	£40,000	£50,000
Yorkshire and the Humber	£47,000	£40,000	£57,000
North East	£44,000	£40,000	£50,000
National average	£48,417	£40,792	£54,292

% increase year on year: 2.5%

contract staff, with 59% of those doing so to meet peaks in demand.

This approach to temporary recruitment is reflected at Hoare Lea. Ford says: 'We keep it at a manageable level: the majority sits with the permanent staff, where we like it to be.' He adds that the company has just been putting the finishing touches to its graduate recruitment programme for the coming year.

Continuing buoyancy in the recruitment market has fed through into salaries, which rose by an average of 2.8% for building services roles last year. This was above the UK average for all UK sectors, which was 1.9%, and for construction and property (2.7%). Two-thirds (63%) of employers in building services had raised salaries in the past 12 months and 59% plan to increase them again in the coming year.

The survey's finding on pay rises tallies at S I Sealy, which awarded an average increase of about 2.5% when it conducted its last salary review in April, says Stafford. The company is now under 'a lot of pressure' from staff to go further this year. It will be difficult to accommodate such a big increase, however, given the fresh jump in auto-enrolled pension contributions, he says, which is due to kick in this April: 'We will probably offer 4%; we can't afford to give six. I don't see where the government thinks we can find that.'

Sutcliffe expects Aecom's across-the-board increase to be close to 2.8%. However, the consultancy giant is one of the building services

employers planning to add staggered increases to targeted staff, as a way of easing salary pressures, he says: 'Good people will always be offered opportunities, so there is tremendous pressure on salaries.'

Hoare Lea has also been offering incremental pay awards to recognise performance, says Ford: 'It's useful to manage the degree of uncertainty while ensuring that those who are performing well are rewarded.'

Last year's average increase of 2.8% across building services is below the previous survey's figure of 3.9% though. Richard Gelder, director at Hays Building Services, suspects this apparent easing of pay inflation marks an end of the post-financial crisis catch-up in salaries.

'We have had four or five years of above-inflation pay and it gets to the point where people are kind of OK. After the financial crisis, there was a real sense of needing to get earnings back and we are past that now. >>

**Contractors: Senior contracts manager**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£47,000	£40,000	£57,000
London	£68,500	£60,000	£75,000
West Midlands	£46,000	£40,000	£55,000
East Midlands	£48,000	£35,000	£50,000
North West	£46,500	£30,000	£48,000
Northern Ireland	£37,000	£37,000	£45,000
Scotland	£43,500	£30,000	£45,000
South East	£65,000	£52,500	£67,000
South West	£46,000	£45,000	£52,500
Wales	£42,500	£40,000	£50,000
Yorkshire and the Humber	£47,000	£40,000	£57,000
North East	£44,000	£40,000	£50,000
National average	£48,417	£40,792	£54,292
% increase year on year: 3.4%			

**Consultants: Associate**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£52,500	£50,000	£65,000
London	£68,000	£60,000	£75,000
West Midlands	£55,000	£50,000	£60,000
East Midlands	£57,500	£55,000	£65,000
North West	£56,500	£50,000	£60,000
Northern Ireland	£51,500	£45,000	£55,000
Scotland	£52,500	£50,000	£65,000
South East	£60,000	£60,000	£65,000
South West	£56,000	£55,000	£60,000
Wales	£51,500	£40,000	£55,000
Yorkshire and the Humber	£43,000	£38,000	£45,000
North East	£48,000	£42,000	£49,000
National average	£54,333	£49,583	£59,917
% increase year on year: 3%			

**Consultants: CAD technician**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£30,000	£25,000	£37,000
London	£34,000	£30,000	£38,000
West Midlands	£27,250	£25,000	£35,000
East Midlands	£28,250	£25,000	£30,000
North West	£28,250	£25,000	£37,000
Northern Ireland	£20,500	£18,000	£25,000
Scotland	£26,000	£22,000	£30,000
South East	£32,000	£30,000	£35,000
South West	£29,000	£25,000	£35,000
Wales	£29,500	£23,000	£30,000
Yorkshire and the Humber	£24,500	£21,000	£26,000
North East	£26,500	£22,000	£29,000
National average	£27,979	£24,250	£32,250
% increase year on year: 2.2%			

**Consultants: Director**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£62,000	£50,000	£70,000
London	£90,000	£80,000	£100,000
West Midlands	£63,000	£60,000	£70,000
East Midlands	£65,000	£60,000	£75,000
North West	£66,500	£60,000	£70,000
Northern Ireland	£61,500	£50,000	£70,000
Scotland	£58,500	£55,000	£70,000
South East	£70,000	£70,000	£80,000
South West	£58,500	£60,000	£70,000
Wales	£55,000	£52,000	£60,000
Yorkshire and the Humber	£51,000	£42,000	£54,000
North East	£52,000	£42,000	£55,000
National average	£62,750	£56,750	£70,333
% increase year on year: 2.2%			

**Consultants: Intermediate M&E design engineer**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£38,500	£33,000	£50,000
London	£39,000	£32,000	£45,000
West Midlands	£33,000	£25,000	£40,000
East Midlands	£35,000	£30,000	£38,000
North West	£35,000	£27,000	£38,000
Northern Ireland	£27,000	£28,000	£33,000
Scotland	£35,500	£30,000	£40,000
South East	£35,000	£30,000	£36,000
South West	£38,000	£33,000	£40,000
Wales	£35,000	£28,000	£40,000
Yorkshire and the Humber	£30,500	£28,000	£40,000
North East	£26,500	£22,000	£28,000
National average	£34,000	£28,833	£39,000
% increase year on year: 2.6%			

**Consultants: Junior M&E design engineer**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£24,500	£20,000	£28,000
London	£29,000	£25,000	£32,000
West Midlands	£24,000	£20,000	£30,000
East Midlands	£26,500	£24,000	£30,000
North West	£26,000	£18,000	£27,000
Northern Ireland	£23,500	£21,000	£26,000
Scotland	£27,500	£24,000	£30,000
South East	£28,500	£22,000	£30,000
South West	£27,000	£20,000	£32,000
Wales	£25,500	£22,000	£30,000
Yorkshire and the Humber	£21,500	£18,000	£25,000
North East	£21,500	£18,000	£24,000
National average	£25,417	£21,000	£28,667
% increase year on year: 3.2%			

We've had more than three years of above-inflation pay across the sector, so it's not a huge surprise that there would be a dip in overall salary rises.'

Employers are also under less pressure to award big pay hikes, Gelder says. 'Inevitably, there was a bit of over pay as people began to rebuild teams, which has settled down.'

Underpinning pay pressures, though, are lingering concerns about skills shortages, reported last year by nearly all (93%) building services employers. More than a third (39%) said skills shortages have had an effect on expansion, while 41% said they have undermined their companies' ability to deliver projects. Nearly a third (29%) of employers said skills shortages have had an impact on employee morale.

This challenge looks set to continue, with 64% of employers expecting to face a shortage of suitable applicants over the next 12 months. The UK's impending withdrawal from the EU is fuelling shortages, says Gelder. 'The availability of EU workers continues to decline against the backdrop of Brexit. In an already skills-short market, this loss of talent has been an extra element in creating pressure, which is feeding into increased competition.'

Sealy's Stafford says it is 'almost impossible' to get good senior electrical engineers, MEPs and BIM operators. Sutcliffe, meanwhile, says Aecom is exploring the possibility of more apprenticeships, and maintaining its 40-strong graduate training programme.

However, retaining engineers once they have achieved chartered status is also a problem, he says. 'We have no problems getting people into the business, but we are seeing challenges with convincing quality staff that want to remain in the industry.'

Increasingly, firms need to think beyond the bottom line to reward employees, says Gelder. 'It's not just about money, but about other things like flexible working.'

Non-pecuniary awards are on the agenda across the sector. 'We are having to do more to keep people,' says Stafford, who explains that Sealy is offering an extra day's holiday on an employee's birthday and health insurance from this April. Gelder says: 'Over the past year, the ones who are smarter are winning the battle for talent.'

Ford argues that the kind of projects Hoare Lea works on are a draw for would-be recruits and existing talent. He cites Deloitte's central London office at 1 New Street Square, which was the first workplace worldwide to be certified Well Gold and Breeam Outstanding. 'It has to go beyond the salary,' he says. 'People need to feel they are doing something of purpose.'



**Consultants: Professional quantity surveyor**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£49,000	£40,000	£55,000
London	£65,000	£50,000	£75,000
West Midlands	£43,000	£35,000	£50,000
East Midlands	£46,000	£45,000	£55,000
North West	£43,500	£38,000	£45,000
Northern Ireland	£35,500	£32,000	£38,000
Scotland	£39,000	£35,000	£50,000
South East	£64,500	£55,000	£70,000
South West	£50,000	£45,000	£60,000
Wales	£42,500	£35,000	£45,000
Yorkshire and the Humber	£41,500	£35,000	£45,000
North East	£39,000	£35,000	£41,000
National average	£46,542	£40,000	£52,417

% increase year on year: 3.2%

**Consultants: Revit/BIM technician**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£32,000	£28,000	£38,000
London	£47,500	£40,000	£60,000
West Midlands	£33,000	£30,000	£40,000
East Midlands	£34,000	£30,000	£40,000
North West	£37,500	£32,000	£45,000
Northern Ireland	£25,500	£24,000	£30,000
Scotland	£31,500	£25,000	£35,000
South East	£42,500	£43,000	£55,000
South West	£38,000	£35,000	£45,000
Wales	£36,000	£30,000	£40,000
Yorkshire and the Humber	£34,000	£28,000	£35,000
North East	£35,000	£28,000	£38,000
National average	£35,542	£31,083	£41,750

% increase year on year: 2.6%

**Consultants: Senior M&E design engineer**

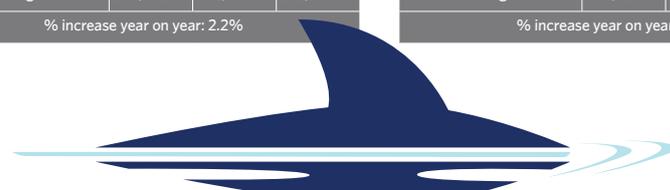
Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£46,000	£40,000	£55,000
London	£55,000	£50,000	£65,000
West Midlands	£44,000	£40,000	£55,000
East Midlands	£48,000	£45,000	£55,000
North West	£46,500	£40,000	£50,000
Northern Ireland	£38,500	£40,000	£45,000
Scotland	£45,000	£40,000	£47,000
South East	£55,000	£52,000	£57,000
South West	£48,000	£45,000	£55,000
Wales	£45,500	£40,000	£50,000
Yorkshire and the Humber	£43,000	£38,000	£45,000
North East	£44,000	£40,000	£45,000
National average	£46,542	£42,500	£52,000

% increase year on year: 2.2%

**Consultants: Sustainability consultant**

Region	Typical salary 2019	Min salary 2019	Max salary 2019
East of England	£51,000	£42,000	£60,000
London	£55,000	£45,000	£60,000
West Midlands	£43,500	£38,000	£48,000
East Midlands	£43,000	£35,000	£45,000
North West	£46,000	£40,000	£50,000
Northern Ireland	£37,000	£30,000	£40,000
Scotland	£43,250	£35,000	£50,000
South East	£43,500	£42,000	£47,000
South West	£45,000	£40,000	£50,000
Wales	£42,500	£38,500	£44,500
Yorkshire and the Humber	£41,000	£36,500	£43,500
North East	£43,500	£40,000	£47,500
National average	£44,521	£38,500	£48,792

% increase year on year: 2.2%





# Stronger together

CIBSE's Young Engineers Network is a great place to meet peers and keep abreast of the latest developments.

**David Blackman** talks to four YEN leaders on the benefits of membership

**T**he transition from studying to the world of work can be tough. For rookie building service engineers, CIBSE helps bridge the gap with its Young Engineers Network (YEN).

This network offers a forum and network of support for young engineers within the Institution, and has a presence in every region of the UK. YEN also has international branches in Australia and New Zealand, Hong Kong, the UAE, and the Republic of Ireland.

In addition to providing platforms for new thinking and exchanging knowledge, each network runs technical and networking events that help young engineers keep up to speed with their CPD requirements.

YEN also promotes building services engineering to the next generation of engineers by representing the profession at events such as school and university careers fairs.

Rebecca Neill, who chairs the Scottish branch, says the networking offered by the YEN is 'invaluable'.

'They [attendees] could be your future colleagues - and could even end up being future clients depending on how their careers go.'

To discover more about the networks, *CIBSE Journal* spoke to Neill and other young engineers who lead the work done by the YEN. >>



» **Munis Hameed**

A couple of years ago, Munis Hameed wasn't even a member of CIBSE. Now he's chair of its YEN worldwide committee.

Hameed heard about the Institution while working in his first job at BuroHappold Engineering, which he joined after completing a Master's degree in sustainability at the Dubai campus of Heriot-Watt university.

The moribund UAE branch of the YEN was revived at a social gathering in Dubai four years ago, after Hameed put his hand up to become its technical officer. Six months after becoming branch chair last year, he took the same role on the global committee.

The 27-year-old got a taste for building services while studying energy conservation during the final year of his undergraduate degree in mechanical engineering at Heriot-Watt. Since starting work more than four years ago, he has worked on some of the Gulf's highest-profile projects. These include the Museum of the Future, where he worked on developing the distinctive façade, which is etched with calligraphy depicting the text of a famous Arab poem.

As well as being an interesting visual feature, the façade offers shading and boosts the sustainability credentials of the museum, which is designed to draw at least 80% of its power from a dedicated solar plant.

Hameed, of Ramboll, observes that clients are increasingly insisting on using BIM technology – a building services trend that he clearly welcomes.

'Sometimes it's hard to get the message across by presenting everything in 2D – but, if you are walking through a building, you can see it from all perspectives,' he says.

'There will come a point where drawings won't be issued in paper but will be produced via an online portal only. It may take a while for authorities to accept digital information instead of paperwork, but I see it happening in my time.'



**Rebecca Neill**

The Scottish branch of the YEN decided to inject some fun into continuing professional development (CPD) by holding a couple of sessions in the pub.

'It was to try to offer a more relaxed environment than your standard CPD and to get people along. It's a bit of a slog for people going somewhere after work,' says Rebecca Neill, chair of the Scottish YEN.

She stresses, however, that those attending the two trial CPD pub sessions, in Edinburgh and Glasgow, are only allowed one drink before they get down to business.

Neill, 27, got involved in building services after completing a mechanical engineering degree at the University of Edinburgh. Her interest was sparked by hearing presentations about the discipline while taking part in the Engineering Without Borders competition at Durham University.

Neill returned to her hometown of Aberdeen after graduating and took a job in the office of Wallace Whittle. She then moved to Edinburgh in 2015, to take an engineer's role at Cundall, where she mainly works on HVAC and public health.

The highest-profile project with which she has been involved is the restoration of the 19th-century City Observatory on Calton Hill, a neoclassical building that overlooks Edinburgh.

Neill admits it's been a 'fantastic project' to work on, and adds: 'It's the first time the buildings have been opened to the public since they were built.'

'The main challenge was the age of building: it wasn't designed for a lot of the modern conveniences we have nowadays.'

The refurbished observatory has its own mini-district heating system, which is powered by a combined heat and power plant.

Another benefit of being involved with the YEN is support when pursuing chartership, Neill says. She is very keen to spread the Scottish branch of the YEN beyond the cities of Edinburgh and Glasgow. She says: 'I'm very keen to expand it up into Scotland, but the challenge is getting people locally to help out with these things outside of the central belt.'

**"If you want to work abroad, or in different sectors, you can: no two days are the same. If you are a good engineer you have a job for life – you are always in demand"**



### **Alexandra Logan MCIBSE**

Vice-chair of the YEN's global committee Alexandra Logan knows first-hand how tough it can be to make the transition from studying to getting established in the building services industry.

It was while completing a combined course in architecture and environmental design at the University of Nottingham that she discovered her preference for engineering. However, she graduated in 2010 – in the aftermath of the late-Noughties' recession, when opportunities in the construction industry were limited.

After working for three years in Nottingham, mainly on primary schools and small office developments, Logan relocated to London, and then to her home county of Kent. As well as giving her the chance to be closer to her family, the move gave the 30-year old opportunities to work on bigger projects in London.

Now, having moved to Chapman BDSP's Kent office as senior mechanical engineer, Logan is working on high-end residential projects.

Promoting health and well building – such as the provision of fresh air to prevent drowsiness and encouraging walking by furnishing staircases – has risen up the building services agenda over the past couple of years, says Logan.

While working on a high-end residential development, one of the key challenges has been reconciling thermal comfort with aesthetic consideration, such as placing grills and louvres behind stone lattice work to hide them from view.

She clearly enjoys working in building services, and highlights the variety of work as a plus point. 'If you want to work abroad, or in different sectors, you can: no two days or two projects are the same.

'If you are a good engineer you have a good job for life – you are always in demand.'



### **Charlotte Mercer**

When she entered the world of building services, Charlotte Mercer never imagined she would end up working for the likes of Google and YouTube.

The chair of London YEN studied environmental engineering and architecture at the University of the West of England in Bristol.

While most of her year group took the architectural route, however, Mercer became an engineer, joining Aecom's graduate scheme at its St Albans office. There, she worked mainly on laboratory and hospital projects, which had been the focus of her university dissertation.

Since moving to Cundall, in London, in 2015, Mercer has changed professional tack. She is now a member of the practice's workplace team, focusing on commercial projects, as well as educational and mixed-use buildings. Her highest-profile work has been for tech giants Google and YouTube.

The 27-year-old was lead electric engineer on Google's engineering building at 6 Pancras Square in King's Cross, where she worked on site for 10 months after being novated to the scheme's contractor.

Mercer also led Cundall's work delivering a new recording studio for YouTube, also located in King's Cross.

While her earlier medical projects and more recent commercial work seem to have little common, they pose shared electrical engineering challenges. Both types of project require highly resilient power supplies. The implications of a power cut for an operating theatre could, literally, be a matter of life and death, but guarding against disrupted supply is also crucial for media and tech companies.

The positive experiences gives Mercer – who became a STEM ambassador while at Aecom – the opportunity to promote building services engineering as a rewarding vocation at the careers fairs to which the London YEN regularly goes.

'Although I was interested in the construction industry, I didn't know what a building services engineer was,' she says. 'So I'm always keen to talk to schoolchildren, because it's a profession that people don't know about.'

# Indoor Climate Solutions CPDs

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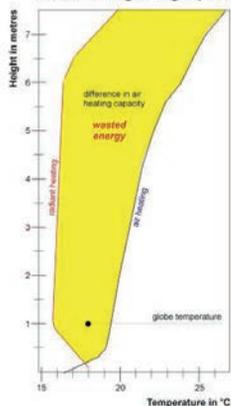
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## CPD Portfolio

Comparison of Radiant Heating and Air Heating in Large Spaces



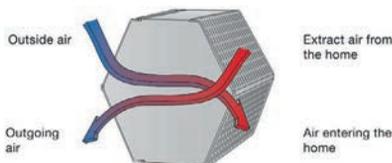
### Radiant Heating

- Learn how resultant perceived temperature affects us
- Learn the features and benefits of radiant heating
- Understand the differences between radiant and convective systems



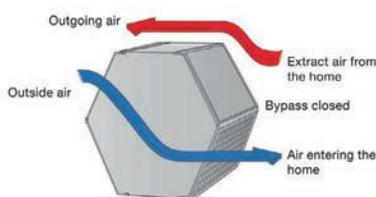
### Radiant Conditioning

- Understand the cooling issues that pertain within buildings today
- Recognise the different cooling solutions and how they work
- Understand the benefits that can be gained by radiant conditioning

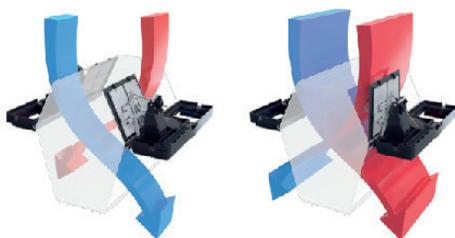


### MVHR in Passive House

- Understand the key principles of MVHR
- Learn about what constitutes a High Code Level and Passive House dwelling
- Understand how to identify the correct heat recovery system for the project



### Residential Cooling via Ventilation



- What is overheating, why is it occurring and what are the implications?
- Regulations and Guidance surrounding overheating in homes e.g TM59

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## MVHR for energy-efficient ventilation and summer cooling

This module considers the application of mechanical ventilation with heat recovery (MVHR) in dwellings for ventilation and energy-efficient summer cooling

Continuous, balanced mechanical ventilation with heat recovery (MVHR) is often applied in new-build dwellings as a means of maintaining controllable indoor air quality with low running costs. Traditionally in northern Europe, the focus has been on its application in dwellings to reduce the heating energy required to heat the incoming ventilation air. However, as building airtightness standards have become more stringent and overheating has emerged as an issue, a dwelling MVHR linked to a simple water/glycol sub-soil heat exchanger can potentially provide cooling for much of the summer, as well as meet the essential need for ventilation air.

Where external climate, as well as the building form and use, combine to provide appropriate conditions, the application of simple, natural ventilation (using manually operated windows, doors and vents, as well as infiltration air) has historically been preferable, and acceptable as a means of providing 'fresh' air – diluting and removing heat, moisture and pollutants for most dwellings in northern Europe and other temperate climates.

The evolution of buildings that have lower design air leakage and improved fabric thermal performance has reduced fortuitous 'ventilation' (infiltration air passing through gaps, open cell materials and openings) and, in conjunction with increased risks of overheating, has led to the demand for a controllable means of ventilation to maintain acceptable indoor air quality (IAQ) while not compromising the energy efficiency of the whole building system. This includes controllable natural ventilation (such as passive stack ventilation) and mechanical ventilation – both methods that have been used successfully.

Each method has its advantages and disadvantages, but the flexibility in air distribution and the ventilation effectiveness of mechanical ventilation will make it suitable for many applications, particularly where there are issues with external noise or air quality.

Increasingly, to maintain acceptable IAQ demands the reduction of large particles, airborne germs and allergens, as well as smaller particulate matter and, in some

cases, nitrogen dioxide (NO<sub>2</sub>). The pressure needed to move air through panel, pocketed, high-efficiency particulate air (HEPA) filters or, for NO<sub>2</sub>, activated carbon filters, will require additional fan power.

An MVHR balanced ventilation system works by extracting vitiated air from inside the dwelling – typically, from bathrooms and food-preparation areas – and supplies treated outdoor air, typically to bedrooms, living rooms and dry areas. The system uses the heat from the outgoing air to warm the incoming air via an air-to-air heat exchanger – typically, a plate heat exchanger – mounted within the MVHR air handling unit (as in Figure 1). A 'thermal bypass' operates when heat recovery is not advantageous, such as in summer and times of high room heat gains where the ventilation is used to provide 'free' cooling. (MVHR is referred to as 'System 4 installations' in the Building Regulations.)

The heat exchanger has historically transferred only sensible heat – though, more recently, total (also known as 'enthalpy') heat exchangers have become available that also transfer latent heat (but do not allow odours to pass from one stream to another). Well-controlled total energy exchange



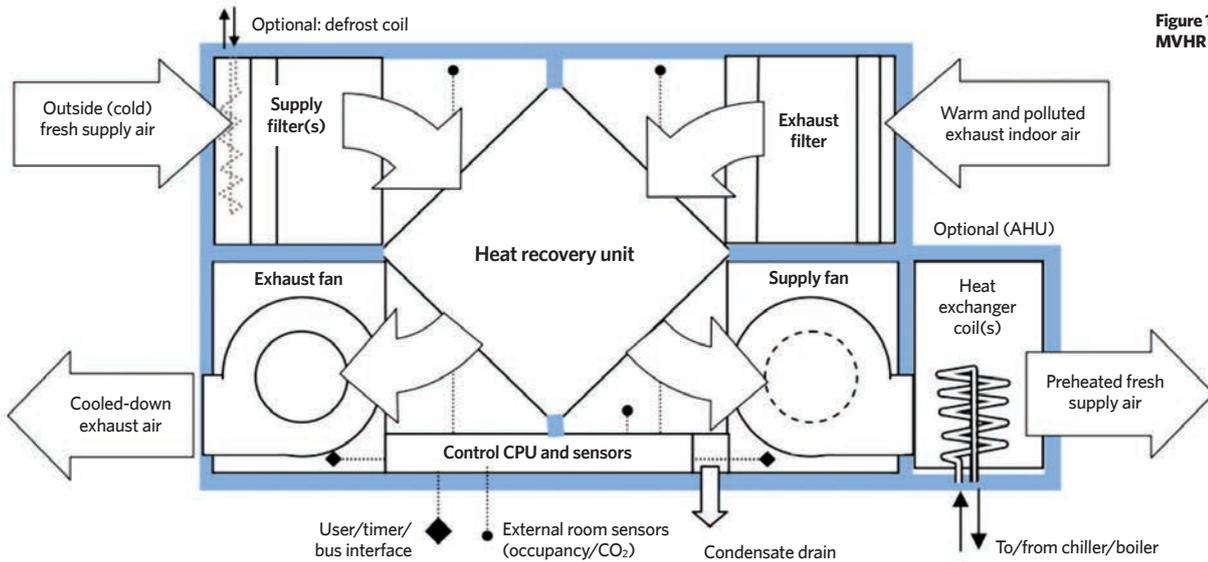


Figure 1: A generic MVHR air handling unit<sup>1</sup>



Figure 2: Example of a commercially available MVHR air handling unit (Source: Zehnder)

» systems should be able to maintain improved dwelling humidity ranges, as well as providing enhanced annual energy performance compared with sensible heat exchangers. MVHR systems – such as that shown in Figure 2 – are capable of recovering 96% of sensible energy, and can automatically adjust to changing demands within the dwelling. Typically, an MVHR system will be designed to operate continuously throughout the year, and systems increasingly make use of variable speed fans to improve control flexibility to meet extreme and normal internal loads without unnecessary noise.

For MVHR to be successful in recovering energy from the extract air, the dwelling must be appropriately airtight so that there is a balance in the supply and extract flowrates through the heat exchanger. This is established as a design parameter for new dwellings – and may be measured in completed buildings – and is typically specified in terms of ‘air permeability’, evaluated at pressures that exceed those

generated by normal wind and stack forces (see ‘Air permeability’ box). A permeability of  $5\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa is highlighted in AD F as a limit value that is typically used as the threshold<sup>2</sup> below which MVHR is commonly applied as a dwelling ventilation system. The default AD F position is that a dwelling would have zero air permeability and so assumes no infiltration and reliance solely on a specific installed ventilation system.

Industry guidance has various values of recommended maximum permeability to enable successful deployment of MVHR, typically ranging from 1 to  $3\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa, although Crawley’s recent research<sup>2</sup> (see page 30) indicates that the vast majority of the UK’s MVHR installations are in dwellings with air permeability of  $5\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa. (The Passivhaus standard requires a maximum dwelling air leakage of 0.60 air changes per hour at 50Pa, that for the example house in the ‘Air permeability’ box (below), would imply an approximate air permeability of  $0.67\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$ .)

### AIR PERMEABILITY

Air permeability is the volume airflow rate per hour per square metre of envelope area at a test reference pressure differential across the building envelope of 50Pa,<sup>3</sup> and is typically quoted in terms of  $\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$ . Specific local regulations and air permeability standards provide varying guidance relating to the building airtightness and the necessity for purpose-provided ventilation. So, for example, England Approved Document L1A – *Conservation of fuel and power* has a high limit to air permeability of  $10\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$ . This is a high value for a modern dwelling and should be seen as an absolute ‘backstop’ – for an 8m x 8m x 5m house it would equate approximately to nine air changes per hour at 50Pa. (The air permeability measured at 50Pa can be approximated to airflow through all external surfaces under typical ambient pressures by dividing by 20 – so, in this case, it would be  $9/20 = 0.45$  air changes per hour.) The recommendations of England Approved Document F *Ventilation* (AD F) indicate that new buildings can readily achieve air permeability down to around 2 to  $4\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa pressure difference and ‘some buildings constructed are tighter than this’.

Summer bypass method	Effect on ventilation performance	Impact on indoor air quality
<b>Shutdown:</b> Turning it off: manual controls to switch off supply in summer.	Creates negative pressurisation because of the supply motor being turned off. If open-flue appliances are present, this negative pressurisation could pose a danger to occupants.	The supply air comes directly through inlets, such as trickle vents, which are typically unfiltered.
<b>Summer slowdown:</b> Reducing the supply air fan speed during the warmer months.	As an MVHR unit needs balanced supply and extract, slowdown of supply air creates negative pressure, leading to uncontrolled and unfiltered replacement air.	Negative pressurisation means the air coming into a home isn’t filtered, potentially bringing in harmful pollutants, such as NO <sub>x</sub> .
<b>Modulating bypass:</b> The summer bypass can be open, closed, or anywhere in between, with enough heat recovery to achieve comfort.	During a cooler summer night, the bypass can remain active, keeping the supply temperature above the dew point, while keeping internal temperatures bearable.	The supply air will continuously be filtered and the supply and extract air will remain balanced even if the bypass is open, closed or modulating.

Table 1: Methods of summer ‘bypass’ functionality<sup>4</sup>

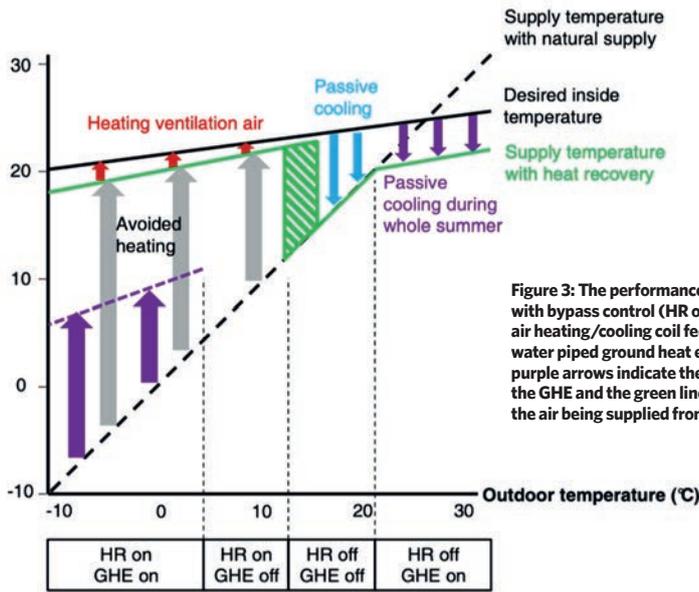


Figure 3: The performance of an MVHR system with bypass control (HR on or off) and intake air heating/cooling coil fed from a pumped water piped ground heat exchanger (GHE). The purple arrows indicate the input resulting from the GHE and the green line the temperature of the air being supplied from the MVHR unit

A balanced MVHR system would typically be designed to supply sufficient outdoor air to meet comfort (and health) requirements. During the heating season, heat is recovered from the extract air to heat the incoming supply air. In the 'shoulder' seasons – where the internal temperature may be allowed to swing without causing discomfort and neither heating nor cooling is needed – heat recovery is automatically reduced or totally switched off by 'bypassing' (see Table 1), so the supply temperature is not detrimentally affected. The bypass would normally only be activated when the heating system is off, to prevent wasted energy use. If the room needs cooling and the incoming air is cooler than the discharge air, then the bypass will be active, but only if direct outdoor air temperature is not so low as to cause draught or condensation. The modulating bypass ensures that in conditions with a risk of condensation, some heat is recovered to maintain the supply air above the dew point of the indoor air. During the warmer season, if the incoming air is warmer than the extract air, recovery takes place, so the warmer incoming outdoor air is cooled by the extract air.

The opportunity for cooling in warmer seasons with an MVHR system tends to be limited to early evening and morning, when outdoor temperatures are lower

Figure 4: An MVHR unit with a close-coupled coil on the inlet that is selectively supplied with heat and cooling from the sub-soil heat exchanger (Source: Zehnder)



than in the room. However, it is possible to extend the useful cooling period, as well as the opportunity for preheating the incoming air in cold seasons, in a northern European climate if a water/glycol closed-loop ground heat exchanger (GHE) is selectively used to supply a coil fitted before the outdoor air enters the MVHR unit. The operation of a system in the Netherlands was monitored by Cremers<sup>5</sup> (located approximately at 52.0N, 6.6E) that employed a GHE comprising 100m of polyethylene tube with an outer/inner diameter of 25/17mm, installed at a depth of 1.20m in the ground and filled with a water/glycol mix. The operation of that system is summarised in Figure 3, with the impact of the GHE indicated by the purple arrows.

Monitored temperatures over a year for two similar MVHR systems are shown in Figure 5 – one includes a sub-soil heat exchanger and coil in the inlet airstream (as shown in Figure 4) and one does not. Referring to the system with the GHE, when heating is required the preheating of the outdoor air by the GHE sourced heat provides supply temperatures closer to the extract temperature. Where cooling is required, the fresh air is precooled to below the extract temperature and, in this case, the ventilation cooling extends across the whole summer season.

The *Domestic Building Services Compliance Guide*<sup>7</sup> specifies a maximum specific fan power of  $1.5W \cdot L^{-1} \cdot s^{-1}$  for MVHR systems – so, in the example 8m x 8m x 5m house, using a ventilation rate of  $0.13L \cdot s^{-1} \cdot m^{-2}$  (from AD F table 5.1b) this would give a continuous maximum fan power of  $1.5 \times 0.13 \times [2 \times (8 \times 8)] = 25$  watts (219kWh per year). If the system incorporates enhanced filtration (HEPA or activated carbon), this will increase significantly.

A 2016 study<sup>8</sup> of 29 UK dwellings that employ MVHR (monitored under the Innovate UK Building Performance Evaluation Programme) identified issues that hindered the successful utilisation of MVHR. These included lack of appropriate building airtightness; incomplete commissioning; poor airflow rates; lack of balance; and inappropriate duct types. The report gives detailed commentary on the problems, many of which would probably have been avoided if the installation had been designed, installed and commissioned in line with the England and Wales *Domestic Ventilation Compliance Guide*.<sup>9</sup> Beyond technical quality, the key message from this and other reports is that it is vital occupants understand the purpose and operation of the system, and that the control and user maintenance (filter and heat exchanger hygiene) is simple and accessible.

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Turn to page 74 for further reading and references. >>

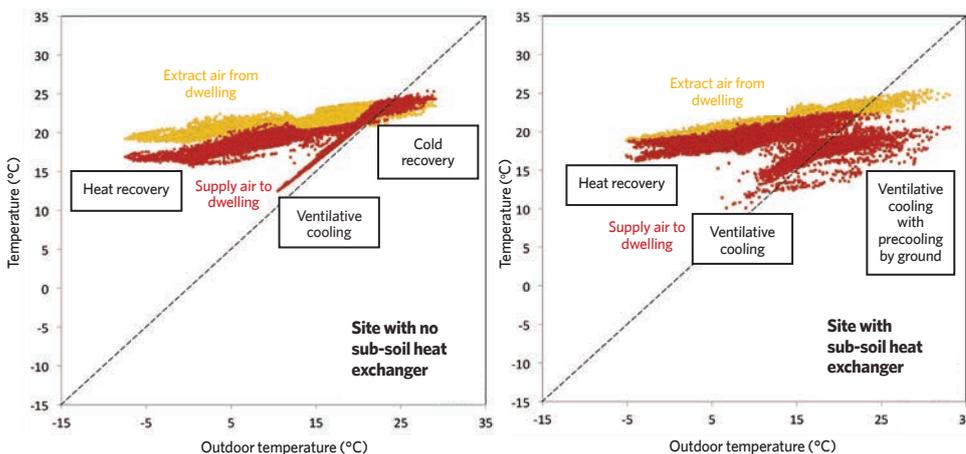


Figure 5: Measured MVHR performance of supply (red) and extract (yellow) temperatures over one year for similar sites – one without and one with a sub-soil heat exchanger



# Module 141

February 2019

» 1. Which of these was not included in the list that may need some reduction through filtration to maintain acceptable indoor air quality (IAQ)?

- A Airborne germs
- B Allergens
- C Carbon dioxide
- D Nitrogen dioxide
- E Particulate matter

2. In the Building Regulations pertaining to England, what system designation is given to an MVHR installation?

- A System 1
- B System 2
- C System 3
- D System 4
- E System 5

3. According to Crawley's research, what is the most likely air permeability found in dwellings where MVHR systems have been installed in the UK?

- A  $0.6\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- B  $1\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- C  $3\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- D  $5\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- E  $10\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa

4. What is the range of maximum dwelling air permeability that is typically considered by the industry as being required for the successful deployment of MVHR systems?

- A Under  $1\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- B Between 1 and  $3\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- C Between 3 and  $5\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- D Between 5 and  $9\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa
- E No greater than  $10\text{m}^3\cdot\text{h}^{-1}\cdot\text{m}^{-2}$  at 50Pa

5. In the graph of example operation of an MVHR with a GHE, at what approximate outdoor temperature did the GHE start to provide useful cooling?

- A 15°C
- B 18°C
- C 21°C
- D 24°C
- E 27°C

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### Further reading:

CIBSE TM60 *Good practice in the design of homes* 2018 (particularly Section 6.4).

### References:

- 1 EC ENTR LOT 6, Final executive summary for ventilation systems.
- 2 Crawley, J et al, The relationship between airtightness and ventilation in new UK dwellings, *BSER&T Online*, 2018 - <https://doi.org/10.1177/0143624418822199>
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- 7 *Domestic Building Services Compliance Guide 2013* (inc 2018 amendments).
- 8 Sharpe, T et al, *Characteristics and performance of MVHR systems*, Mackintosh Environmental Architecture Research Unit, 2016.
- 9 *Domestic Ventilation Compliance Guide*, DCLG, NBS 2011.



# With the ESOS Phase 2 deadline approaching are you ready to advise?

CIBSE Training's one-day course is designed for those wishing to gain a thorough understanding of the legislation and the compliance process for Energy Savings Opportunity Scheme (ESOS).

## Upcoming training dates:

**3 April 2019** | Manchester

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# PRODUCTS & SERVICES

## New outdoor steam humidifiers from Condair

Humidification specialist Condair has extended its range of electric steam humidifiers to include new IP55-rated models suitable for outdoor installation. The robust enclosures on the Condair RS resistive steam and Condair EL electrode boiler steam humidifiers enable the units to be located on rooftops and exposed to the elements.

The enclosures incorporate a thermostat-controlled heater and fan unit to maintain the internal temperature at an optimum level with outside ambient conditions ranging from -20° to 40°C.

■ Call 01903 850200, email [uk.sales@condair.com](mailto:uk.sales@condair.com) or visit [www.condair.co.uk](http://www.condair.co.uk)



## Genesis Biosciences appoints Admiral Cleaning Supplies as sole UK distributor

Microbial and anti-microbial product developer Genesis Biosciences has appointed Admiral Cleaning Supplies as the sole UK distributor for its professional probiotic cleaning range.

The partnership will see Admiral offer environmentally responsible cleaning solutions to the UK HoReCa and Soft FM and cleaning markets.

The Evogen Professional range includes application-specific microbial strains and eco-benign chemistry that work in synergy to continue to break down soiling after application. This ensures the products deliver a cleaning performance that lasts longer, and is safe for the environment.

■ Call +44 (0)29 2079 1185 and email [info@genesisbiosciences.com](mailto:info@genesisbiosciences.com)



## Warm air, radiant and heating products are affected by European regulations

Warm air heaters are subject to Lot 21 of the directive and radiant heaters Lot 20. Minimum efficiencies for warm air are now 72% and radiant heaters are now 74%. These minimum criteria are applicable for both new installations and when replacing existing products. As a result, customers can be assured that the heating equipment they are purchasing is highly energy efficient and emissions of harmful environmental pollutants are constrained.

Nortek's ErP-compliant range includes the highly efficient Nor-Ray-Vac – a gas-fired continuous radiant tube heating system designed specifically for the building it is required to heat.

It is designed to supply uniform heat coverage over the entire floor area. The system can also cater for distinct zones, offering a varied degree of comfort level within the overall layout of the building. With increased comfort, along with a reduction in operating costs of up to 60% over conventional systems, Reznor will help keep end users operating costs down.

■ Email [erp@nortek.com](mailto:erp@nortek.com) or visit [www.nortek-erp.com](http://www.nortek-erp.com)



## The multifunctional Belimo energy valve now cloud-based

With the integration of the Belimo energy valve into the Belimo Cloud, the users create their own account to have full transparency about the energy consumption in the cooling/heating application – from anywhere and whenever they want. Access to the Belimo online services makes life easier and gives the security to always have the best settings for the devices.

Integrated logic and sensors supply accurate coil-performance data. Energy-monitoring data is used to verify system performance during commissioning and acts as a baseline standard for system performance over time. Transparency, with respect to energy consumption for heating and cooling, is achieved.

Cloud connection is used to control, optimise and monitor energy use and offers advanced system data reporting, driving product and system functionality. Enhanced communication allows for expanded system integration and BMS control with the addition of Modbus RTU and TCP/IP. Other integration possibilities include BACnet MS/TP and BACnet IP, Belimo MP-Bus, and one analogue connection.

■ Visit [www.belimo.com](http://www.belimo.com)



## Mitsubishi Electric launches cost-effective R32 models

Mitsubishi Electric has unveiled a new line of R32 products designed to meet the need for cost-effective air conditioning using low GWP refrigerant. The new R32 M Series MSZ-HR wall-mounted system blends energy efficiency with a compact and stylish design, with the entry-level offering to the M Series product range being ideal for applications requiring a small-scale, highly efficient system.

Making use of Mitsubishi Electric's inverter-driven technology, the wall-mounted range is available in 2.5kW, 3.5kW and a new 5.0kW system sizes. The new series uses R32 refrigerant, which has a significantly lower global warming potential (GWP), helping users to reduce their impact on the environment while, at the same time, delivering comfortable air temperatures to building occupants.

As part of Mitsubishi Electric's commitment to greater energy efficiency from its products, the new MSZ-HR series comes with an optional Wi-Fi capability, enabling control and monitoring of each system using smartphone, tablet or PC via the MELCloud app.

■ Visit <https://les.mitsubishielectric.co.uk/>



## 42 Berners Street development transforms Fitzrovia

AET Flexible Space, provider of underfloor air conditioning systems, has completed the supply and commissioning of equipment at 42 Berners Street, Fitzrovia.

Underfloor air conditioning was put forward as a mechanical services option that could help meet the aspirations of the planners. By adopting a low-level services strategy, designers were able to maximise the available space, adding a seventh floor to the building originally designed with six, and maximise the internal floor to ceiling heights on each floor.

Each floor is divided into separate zones and supplied with fully conditioned chilled or warmed air, which is fed into the plenum by the zonal downflow units (CAM), and then supplied into the workspace via fan terminal units (Fantile).

The system specified at 42 Berners Street is a CAM-C direct expansion system, installed throughout the seven office floors with each floor divided into two separate zones, each served by a CAM-C25 downflow unit.

Call 01342 310 400 or email [aet@flexiblespace.com](mailto:aet@flexiblespace.com)



## Gary Banham joins Hamworthy sales team

Gary Banham, who has 20 years' experience in the sector, is a new sales manager at commercial boiler manufacturer Hamworthy.

During his career, Banham brought his technical and industry knowledge to Goodwater, covering the South East of England in a specification and contractor sales capacity. He was actively involved with the Society of Public Health Engineers (SoPHE) and the CIBSE Young Engineers Network (YEN) where he made a name for himself as a water hygiene expert.

Call 01202 662500, email [sales@hamworthy-heating.com](mailto:sales@hamworthy-heating.com) or visit [www.hamworthy-heating.com](http://www.hamworthy-heating.com)



## Systemair Access – touch-screen controller for AHUs

Systemair has launched a complete control solution for air handling units – Systemair Access. The new control makes it easier than ever to make the most of the advanced technology in Systemair's Geniox and Topvex air handling units. Systemair Access consists of Access NaviPad; a newly developed navigation tablet for industrial use, and Access control unit offering state-of-the-art connections such as remote control via mobile devices, BMS integration and the cloud service, Systemair Connect.

Systemair has worked to simplify the operation and monitoring of their air handling units. As more smart features are integrated into today's advanced air handling units such as Geniox, it's important to enable maximum use.

The NaviPad is a robust, IP54-classified navigation tablet, designed for industrial use with a user-friendly graphical interface. The new control system offers users full connectivity and control. Thanks to the HTML5 interface, navigation is not limited to the NaviPad, but also includes tablets, smartphones and laptops.

Call 0121 322 0200 or visit [www.systemair.co.uk](http://www.systemair.co.uk)



## Mikrofill's HWS loading cylinder goes to new extremes

The pioneering Extreme hot water loading cylinder from Mikrofill Systems now delivers hot water at 6 bar, nearly doubling its previous capability.

Available in 200, 300 and 500-litre models, the WRAS-approved stainless steel loading cylinders can all accommodate 120kW of primary input at 80°C. The net result is an instantaneous secondary performance of more than 2,000 litres per hour at 60°C on all models, with the 500 litre model producing 2,570 litres per hour.

The Extreme is designed to operate at a Δt of 30°C on the primary side, maximising a condensing boiler's efficiency while initially loading and further producing 60°C instantaneous hot water. It also has an onboard automated/manual pasteurisation programme.

Call 03452 606020 or visit [www.mikrofill.com](http://www.mikrofill.com)

## Ideal Commercial free commissioning extended

Ideal Commercial Boilers is pleased to announce the extension of its award-winning free commissioning offer. Available on all Evomax, EVO S, Imax Xtra, Imax Xtra EL and Evomod condensing boiler ranges, free commissioning can be claimed on installations until 31 December 2019.

Introduced in January 2018, this service was an industry first and has made a major impact on specifiers, merchants and installers. Not only does it reduce customer costs, commissioning carried out by Ideal Commercial ensures boilers are operating correctly and activates the warranty, which can be up to five years.

National sales manager Andy Forrest said: 'Free commissioning is a fantastic offer that further positions Ideal Commercial as the market leader for commercial boilers in the UK.'

To apply for free commissioning on an installation, customers have to complete a straightforward online form that is sent directly to Ideal Commercial's customer service team.

Bookings are then confirmed via email or telephone.

Call 01482 492251, email [commercial@idealboilers.com](mailto:commercial@idealboilers.com) or visit [www.idealcommercialboilers.com](http://www.idealcommercialboilers.com)





## Expected winter whiteout means autos should be checked >

Carrying out weekly checks on automatic doors in the run-up to the UK's envisaged bad weather is being urged by experts from Geze UK.

Weather forecasters are predicting a polar cold snap – not the time to find that automatic doors are no longer working properly.

Geze UK's service director Steve Marshall said ensuring doors are properly maintained and working correctly will help reduce heat loss, reduce the chances of water ingress – minimising the chance of slips or trips – and reduce carbon footprint and CO<sub>2</sub> levels into the building.

He advised estate and facilities managers to put in place weekly checks to ensure doors open and close with maximum efficiency. In addition, dutyholders need to prepare for snowy and icy conditions and minimise risk. The HSE's Approved Code of Practice (ACoP) L24 for the Workplace (Health, Safety and Welfare) Regulations notes in paragraph 96 that this might include 'gritting, snow clearing and closing off some routes, particularly outside stairs, ladders and walkways on the roof'.

Marshall added: 'Generally, weather conditions in the UK tend not to be so severe but, during the winter months, we should prepare for the worst and hope for the best. Carrying out this simple 10-point plan throughout the year should help keep automatic doors working at their best and keep anyone walking over our thresholds safe and secure.'

■ Call 01543 443000 or visit [www.geze.co.uk](http://www.geze.co.uk)

## CIAT UK opens two new AHU and HVAC technology training centres >

CIAT UK is opening two new training centres to update customers on its latest air movement and air conditioning technology. The facilities, at Leatherhead and Stockport, include new showrooms for CIAT equipment and are part of the company's drive to develop the practical hands-on skills of engineers involved in installing and servicing CIAT's growing range of air-side and air conditioning equipment.

The training centres will operate alongside the existing UK training network of sister company Toshiba Air Conditioning, which has 13 dedicated facilities across the country, and augment CIAT's global training centre located at Culoz in south-eastern France, at the heart of CIAT's main manufacturing and research and development site.

CIAT UK head of sales Paul Smith said: 'The new training centres and showrooms will enable specifiers, installers and service companies to get up to speed with the latest technology and gain hands-on experience with equipment and controls. The aim is to equip contractors to deliver outstanding service to their own customers.'

■ Visit [www.ciat.uk.com](http://www.ciat.uk.com)



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## < Grundfos go beyond the pump

Pumps are big energy consumers that currently account for 10% of global electricity and many are needlessly inefficient. Today, by focusing on changing to high-efficiency pumps that incorporate advanced motor technology, an average pump's energy consumption can be cut by up to 60%.

To achieve the highest overall efficiency, the complete installation needs to be examined, as opposed to just viewing the pump in isolation,

## Toshiba rolls out flammable refrigerants training for air conditioning installers >

Toshiba Air Conditioning has launched its Flammable Refrigerant Training Programme for installers, designed to ensure safe handling of R32 and other flammable refrigerants during installation, servicing and ongoing operation. TCUK is a joint venture between Toshiba and Carrier in the UK, a provider of innovative heating, ventilating and air conditioning (HVAC), refrigeration, fire, security and building automation technologies.

It follows Toshiba's announcement last year that it was switching to R32 for use in split and multi-split air conditioning systems immediately, and for use in air-to-water heat pumps starting in mid-2019. The change is the result of the phase-down in use of widely used refrigerant R410A, which has a higher global warming Potential, under the F-Gas Regulations.

Sales director at Toshiba Air Conditioning Neil Hitching said: 'We are pleased to be able to provide installers and service companies with the theoretical and practical knowledge required to handle R32 and other flammable refrigerants safely.'

■ Visit <http://www.toshiba-aircon.co.uk>



**Elco Heating Solutions welcomes new UK sales manager**

Stuart Turner has been appointed national sales manager for Elco Heating Solutions. Having worked in the commercial heating industry for more than 35 years, he has a wealth of experience and knowledge in all aspects of the sector.

In his new role, Turner will be responsible for growing market share and developing new business for Elco with consultants, contractors and installers throughout the UK.

He said: 'I'm incredibly excited by the opportunities available for the company over the coming years.'

■ Visit [www.elco.co.uk](http://www.elco.co.uk) or follow @elco\_uk on Twitter or LinkedIn



**Dunham-Bush at the nerve centre of V&A Dundee**

Dunham-Bush has supplied Leopard fan coil units and BM fan convectors to the new V&A Dundee, an £80m international centre of design.

Dunham-Bush fan coil units were selected not simply to meet thermal and airflow rate requirements, but also to satisfy noise-level constraints, while fitting comfortably within the limited space available in the ceiling voids.

Designed by Japanese architect Kengo Kuma, V&A Dundee was 10 years in the planning and is the first dedicated design museum in Scotland.

■ Call 023 9247 7700, email [info@dunham-bush.co.uk](mailto:info@dunham-bush.co.uk) or visit [www.dunham-bush.co.uk](http://www.dunham-bush.co.uk)



**Rinnai A-rated Infinity range for a low NO<sub>x</sub> infinite supply of safe hot water**

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■ Visit [www.rinnaiuk.com](http://www.rinnaiuk.com)

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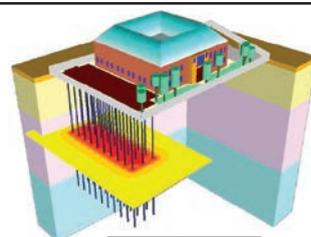
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## Senior/Principal Mechanical Engineer Central London, £50k - £65k + benefits

My client is dynamic, innovative, and creative. We are looking for individuals that share similar traits on behalf of one of London's most pioneering and progressive MEP consultants. You will be working in partnership the world's leading architects on some of the most iconic and complex projects in London and overseas. Ref: 5322

## Intermediate/senior mechanical engineer London, £38k - £45k + benefits

Leading consultancy established 25 years ago require a Senior Mechanical Engineer for their London office. Duties will include leading project surveys, feasibility reports, design, specification, on-site supervision and management of mechanical services installations under guidance from Principal Engineers, seeing projects through to completion and handover. Experience using IES, Revit, and SAP is desirable. Support becoming chartered, bonus scheme, private healthcare offered. Ref: 5324

## Technical Manager (Mechanical) Central London, £75k + benefits

This is an exciting opening to work on some of London's flagship projects ranging from £30 - £80 million construction value, with a specific focus on large scale mixed use projects. You will be acting as Mechanical Technical Manager on this project liaising directly with in house design teams and external stakeholders. Ref: 4976

## Lead Mechanical Engineer Cambridge, £45 - £48p/h

A multi-disciplinary consultancy has a need for a Lead Mechanical Engineer on a large pharmaceutical site in Cambridge. Suitable engineers need to have experience using Hevacomp and Revit whilst being flexible on location. You will be split between the office and site, providing design, review and comment on contractor's working drawings. Ref: 4930

## Mechanical Resident Engineer London, £45p/h

Join one of the UK's leading M&E Design consultancies. This client has designed and managed some of the UK's most iconic residential projects. They have an urgent need for a Mechanical Resident Engineer on a large site in London. You will have a min of 5years experience and be able to communicate effectively at all levels. Ref: 5287

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### Thank you

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– David Wood, Chair of the CIBSE Benevolent Fund Trust.

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Children take part in Emma Beadle's lighting workshop



Emma Beadle

## Flicking a switch

Emma Beadle, SLL Young Lighter of the Year, explains how much the industry can gain by firing up the imagination of students at an early age

In winning SLL Young Lighter of the Year 2018, Emma Beadle engaged with a large demographic that is largely overlooked by designers – children.

Beadle, a lighting engineer at WSP and graduate of Edinburgh Napier's MA Lighting Design programme, impressed judges with her paper *Children's Utopian Vision of the City: co-designing lighting masterplans through play and exploration*.

The article described how she engaged with young children on lighting design using co-design methods of working around observation, interviews and workshops.

Beadle, who also won the award for the best written paper, said children should receive an education in lighting design to develop problem-solving skills and to enhance their personal development. She is keen to raise awareness of a career in lighting and attract greater numbers of young people to the industry.

A video explaining Beadle's project can be viewed at <http://bit.ly/CJFeb19QA>

### Why is it important to involve children in lighting design?

It is important to work with children as it teaches them valuable skills such as problem solving, teamwork and creative thinking. By introducing children to the field of lighting, and the idea of lighting design, it gives young people a glimpse into the lighting world, the roles and responsibilities of lighting designers and, thereby, possibly encourage them into a future career in the industry.

### What can children bring to lighting projects?

Children bring a new perspective to a project. Working with younger children can be very beneficial as, at their age, the line between what is real and what is not is not set in stone, so their imagination can be much more creative than adults.

### How did you develop the co-design methods? What worked best?

Co-design methods were developed from the adaptation and combination of adult co-design methods and university-level lighting teaching methods. These combined methodologies were then tried and tested on the children from the utopian workshops. Through observation and feedback from the children, the methods were adapted further for the Lighting Club, where we designed the Children's Tool-kit of Light. Workshops appeared to be the most successful way identified, as they incorporated several methods and created an environment for the children's development.

### What is in the children's Tool-kit of Light? What works best?

The Children's Tool-kit of Light contains the tools for several lighting games, along with a manual designed and written by the children of the Lighting Club. These include: stencil; glow stick; where's the light?; blocks and bubbles; draw a picture of light; and material box. I handed out feedback forms after the workshops which revealed that the glow stick game was the favourite.

### Was there anything the children came up with that surprised you?

The most surprising thing about working with the children was realising that they did know a lot about light, but they found it difficult to articulate their thoughts on the concept of light. However, by using a mixture of drawings, models and other materials, it helped the children to demonstrate their knowledge and, when in a relaxing, playful atmosphere, they began to discuss their design ideas and thoughts.

### What can designers learn from children?

Adults can learn a new way to look at their project, and get a glimpse at how children see the world. By engaging with children as design partners and experimenting with light or other design aspects together, adults can come across new ideas.

### Can anyone use the Tool-kit of Light?

Throughout this year, I will be developing the Children's Tool-kit of Light to make it accessible for more people. I will also upload the children's manual on how to play each game, as a guide and inspiration for fellow designers to go off and run similar workshops.

### What was the most effective way of engaging with children?

The most effective way of engaging children was by creating an environment of fun and exploration. The lighting games allowed the children to learn about some of the basic characteristics of light in a fun and 'hands on' way. Lighting is a complex subject and, as such, it would be difficult to teach children about light solely through oral methods.

**EMMA BEADLE** is an assistant lighting engineer at WSP

# EVENTS

## NATIONAL EVENTS AND CONFERENCES

### **CIBSE Building Performance Awards** 12 February, London

Winners of the new Building Performance Engineer and 13 other awards will be revealed at the event that celebrates excellence and achievement across the industry. With guest speaker Dr Sarah Pritchard, partner, Buro Happold Engineering. [www.cibse.org/bpa](http://www.cibse.org/bpa)

### **CIBSE TRAINING**

For details, visit [www.cibse.org/training](http://www.cibse.org/training) or call 020 8772 3640

### **Standby diesel generator** 4 February, London

### **Mechanical services explained** 5-7 February, Birmingham

### **Low carbon consultant design training** 6-7 February, Manchester

### **Air conditioning inspection for buildings** 7 February, London

### **Fundamentals of digital engineering (including BIM)** 8 February, London

### **Overview of IET wiring regulations (18th edition)** 11 February, London

### **Fire sprinkler systems: design to BS EN 12845** 11 February, London

### **Emergency lighting to comply with fire-safety requirements** 12 February, London

### **Below-ground building drainage**

### 15 February, London

### **Fire safety in purpose-built blocks of flats** 15 February, London

### **Mechanical services one-day overview** 18 February, London

### **Fire safety building regulations: Part B** 19 February, London

### **Introduction to the heat networks code of practice** 19 February, London

### **Running projects effectively** 20 February, London

### **Heat networks code of practice** 20-21 February, London

### **Building services explained** 25-27 February, London

### **Overview of IET wiring regulations** 26 February, Manchester

### **Designing water efficient hot and cold supplies** 27 February, London

### **Fire-detection and alarm systems for buildings: BS 5839 Part 1** 28 February, London

### **Heat networks code of practice – half-day update** 28 February, London

### **Practical project management** 28 February, London

### **Air conditioning inspection for buildings** 1 March, Birmingham

### **Lighting: Legislation and energy efficiency** 4 March, London

### **Mechanical service explained** 6-8 March, London

### **The importance of energy efficient buildings** 6 February, London

### **Low carbon consultant design training** 7-8 March, London

### **Energy strategy reports** 11 March, London

### **Fire-risk assessment to PAS 79** 12 March, London

### **Heat networks code of practice** 13-14 March, London

## CIBSE GROUPS, SOCIETIES AND REGIONS

For more information about these events, visit: [www.cibse.org/events](http://www.cibse.org/events)

### **Southern: The smart future for BMS** 7 February, Brighton Terry Sharp, BCIA vice-president, on BMS and its role in smart integrated buildings.

### **CIBSE membership application workshop** 8 February, Bristol CIBSE interviewers will help applicants get started on the report for Associate and

Member applications.

### **CIBSE ANZ: Power outage solutions**

12 February, West Perth  
Presentation on reliable back-up power equipment by Magellan Power.

### **HCSW: Grenfell review explained**

13 February, London  
Technical presentation and Expert Witness report with Hywel Davies, CIBSE and Marin Weller, Atkins.

### **West Midlands: Firestop systems – saving lives and protecting assets**

13 February, Birmingham  
Overview of current building regulations and Hilti's firestopping solutions; plus, how products are approved.

### **North West: Rising sea levels**

13 February, Preston  
Technical meeting with John Englander, of the International Sea Level Institute.

### **HCNE: Virtual reality in the construction industry**

19 February, London  
A CPD presentation by Kam Dhatt, director of Onlight VR.

### **CIBSE UAE: Annual dinner**

20 February, Dubai  
With speaker Simon Penney, HM's Trade Commissioner for the MEAP, from the British Embassy, Dubai.

### **Fire and Façades: An update**

26 February, London  
Hosted by the Society of Façade Engineering.

### **North West: BS7671: 2018 – 18th edition**

28 February, London  
Presentation by Geoff Hughes, technical manager, Hager UK.

### **SLL LightBytes**

28 February, York  
In collaboration with CIBSE FM Group. CPD peer-reviewed, bite-sized presentations. [www.cibse.org/sll](http://www.cibse.org/sll)

### **East Midlands: Annual dinner**

8 March, Nottingham  
With stand-up comedian and writer Paul Boardman.

### **North East: Expert Witness**

12 March, Newcastle  
Gerry Brannigan, of HKA, on expert witness work within building services engineering.

## HIGHLIGHT



John Englander will speak at the North West event on 13 February

## CIBSE Technical Symposium 2019

25-26 April, University of Sheffield

The symposium offers an opportunity to examine and share research, development and applications that will drive change in the regulation, creation and maintenance of the built environment. It will also present evidence of where there are still clear opportunities to benefit from established practices.

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For more information and to book a place, visit [www.cibse.org/technicalsymposium](http://www.cibse.org/technicalsymposium)





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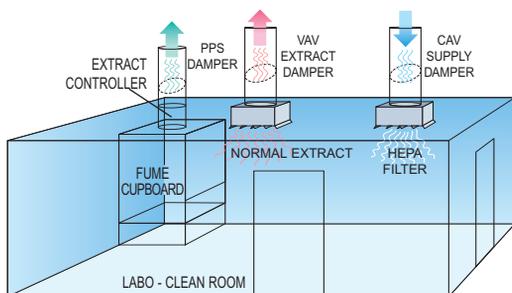


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