CIBSE JOURNAL

The official magazine of the Chartered Institution of Building Services Engineers

December 2016

WITH THIS ISSUE *CPD Special*

FANTASTIC BEAST

How the University of Cambridge's brutalist landmark was tamed

NOT JUST FOR CHRISTMAS
Optimising church heating over the winter

REMOTE CONTROL
Keeping scientists safe in Antarctic research stations

LIGHTING SPECIAL INSIDE

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Cold comfort

Anyone watching Sir David Attenborough's latest series of *Planet Earth* will be reminded of his contribution to the promotion of the natural world. To honour his work in this area, two initiatives have been named after him recently. The Sir David Attenborough building in Cambridge was formerly called the Arup Building and was famous for its brutalist architecture. On page 24, we look at how Buro Happold and Nicholas Hare Architects refurbished it to the highest environmental standards without compromising the design intent of the original building.

The British Antarctic Survey's (BAS) new research vessel has also been named after the TV naturalist – despite the great British public voting to call the ship 'Boaty McBoatface'! However, unlike other popular votes in 2016, the results were non-binding and the BAS sensibly plumped for *RRS Sir David Attenborough*.

The ship will replace two vessels, which currently carry supplies to BAS's five research stations in the South Atlantic and Antarctica. Having only one ship will mean fewer trips 'South', so energy efficiency at the stations is even more important, because emergency re-supplies of fuel will be less likely. To ensure heat and power is provided effectively, the stations are monitored remotely from the UK, in a way that is rarely seen in buildings in the northern hemisphere (page 52).

> Stations are monitored remotely in a way that is very rarely seen in buildings in the northern hemisphere

The health and wellbeing of scientists is also of the utmost importance as as there is no way of getting external medical help to the most remote stations, for much of the year. Halley VI is in darkness for 105 days and sea ice means access by ship is virtually impossible, so indoor air quality (IAQ) is monitored from the UK to ensure that internal environments are healthy.

Experts discussing IAQ at the CIBSE Building Performance Conference warned of the rising threat to occupants of poor air quality, both outside and within buildings, and how measuring IAQ is crucial to maintaining healthy structures.

Cundall's Alan Fogarty spoke about the increasingly influential Well Building Standard, which states that building managers must be able to reduce the concentration of CO_2 in a space to 800ppm, and keep ozone and volatile organic compounds to a minimum. With nearly 12,000 premature deaths caused by nitrogen dioxide air pollution a year, it's clear that the role of the building services engineer is vital in this growing field of study.

Alex Smith, editor
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NEWS

All the latest news from around the building industry

CAMBRIDGE TO GET EUROPE'S FIRST 'ECO-MOSQUE'

Europe's first eco-friendly mosque is to be built in Cambridge.

The building, which will include a 1,000-capacity prayer hall, will benefit from high thermal-performance materials and air source heat pumps instead of gas boilers.

The M&E design, delivered by Skelly & Couch, includes a combination of static heating and natural ventilation, supplemented by high-level extract fans at times of high occupancy or high heat gains, to minimise energy consumption.

LED lighting will be employed, but no artificial lighting will be necessary during daylight hours.

Rainwater will be harvested to flush WCs and for irrigation of the grounds and landscaping. The building's low initial carbon footprint will further improve over time as more electricity is delivered by renewables, the design team added.

CIBSE engineer wins IoD award

CIBSE member Paul Bennett has been named the Institute of Directors' (IoD) New Chartered Director of the Year 2016.

The executive chairman of energy efficiency firm b:ssec was up against directors from across the UK. He is now one of 1,000 to have achieved IoD chartership – launched 10 years ago 'to equip directors with the all-round skills, knowledge and understanding required to direct an organisation from a strategic perspective'.

Bennett (below) set up b:ssec in 2005, having identified the growing market for low carbon, low energy buildings. He said becoming a chartered director had 'transformed our business, particularly in areas such as governance and strategy'.

'Energy is a very political and volatile arena, so every business within the sector needs to be agile to survive,' added Bennett.

BIM driving too much design too early at expense of innovation

Patrick Bellew blames building information modelling for pushing up drawing costs

The 'rise of BIM' is having unintended consequences for how building services engineers approach design, according to Patrick Bellew, principal of Atelier Ten.

He told the CIBSE Building Performance Conference that BIM was prompting design teams to start work on detailed designs too early in the process, so reducing innovation and creative thinking on projects. 'We are modelling too much too soon,' he told delegates at the QEII Conference Centre in London. 'The danger is that you get locked into the model too quickly, which makes it difficult to make changes later in the process.'

'We are spending too much time on the exact geometries for the model and not enough time thinking about the physics of the building,' he added.

He summarised the 1994 Latham Report as saying that consultants should design less and contractors design more. BIM is reversing this process, said Bellew. 'We are producing fantastic drawings of beautifully rendered systems that will never be installed because the contractor will change the manufacturer.' He also said BIM was driving up costs, with the drawing process now accounting for more than 20% of his practice overheads – up from 8% before BIM.

Former CIBSE President Max Fordham called for engineers to rely less on computer algorithms and do more 'intuitive' design. 'It wasn't a computer algorithm that designed the burial chamber in a pyramid where the temperature has been maintained at a constant 20°C for 4,000 years,' he pointed out.

See page 16 for more from the conference.

Compliance focus leads to problems

Engineers focus too much on complying with legislation rather than delivering a building that performs well, the CIBSE Building Performance Conference heard.

Sarah Ratcliffe, programme director at the Better Buildings Partnership, said designing for compliance with the Building Regulations was embedding poor performance into buildings.

'Engineers' simulations ignore process imperfections and how buildings are operated,' she said. 'It is not clear who is responsible – or who is incentivised – to make buildings perform well. This is not a technical issue, but a cultural and process problem.'

Ratcliffe urged the industry to respond to property owners' appeals for more accurate performance data and to design for long-term operation. She added that the UK should learn from Australia's Nabers system, which demonstrates a significant value return on highly rated buildings and makes the link between efficiency, health and wellbeing, quality and value.

'Building services engineers have fallen into the trap of focusing on design, but they should give equal weight to commissioning, delivery, operation and refurbishment,' said Ratcliffe. 'We also want you to get the basics right and focus on outcomes for people.'

Skills shortage threatens to derail Chancellor's promises

- **Autumn Statement covers infrastructure, housing, productivity and R&D**

Increasing infrastructure investment to between 1% and 1.2% of gross domestic product (GDP) each year from 2020 to 2050 was a key commitment from the Chancellor of the Exchequer, Philip Hammond, in his Autumn Statement. He also pledged £390m by 2020-21 to support ultra-low emissions vehicles, renewable fuels, and connected and autonomous vehicles.

Plans for an additional £2bn of investment in science and research and development (R&D) were confirmed, and Hammond cancelled the fuel-duty rise for the seventh successive year. To tackle the productivity gap, he vowed to spend £23bn on innovation and infrastructure over five years.

However, critics say, the issue isn't the government's commitments – but their delivery.

Hywel Davies, CIBSE technical director, said: 'The critical question is whether we can attract the skills needed to deliver these commitments. Government will need to consider this as it reviews immigration policy, or we may find we are really struggling to obtain good value for this spending of taxpayers' money.'


Philip Hammond

PETER R FOSTER IDMA / SHUTTERSTOCK

Other key promises

- A new Housing Infrastructure Fund of £2.3bn by 2020-21
- £1.4bn to deliver an additional 40,000 houses
- Maintaining the cap on Carbon Price Support rates at £18t/CO_2
- The Levy Control Framework, setting limits on support for renewable electricity generation, to be set out at the Budget in 2017
- £170m for flood defence and resilience measures
- Corporation tax to be cut to 17%, and tax breaks for the North Sea oil and gas industry to be extended
- Carbon price floor to be retained at current levels until at least 2020

Davies said a skills shortage could mean buildings are badly built and fail to perform as required, possibly compromising occupants' productivity. 'We need to upskill at present capacity; if we have to deliver more output, that upskilling gets more demanding.'

A recent Royal Academy of Engineering report, *Engineering a future outside the EU: securing the best outcome for the UK*, confirmed that access to skilled workers and academics was critical for the future success of the sector. Released in October, it says that uncertainty about the status of EU workers in the UK, and other risks to the supply of skilled engineers, are likely to result in delays to projects such as HS2, Thames Tideway and Hinkley Point C.

Miles Barnard, managing director of Mouchel, part of WSP Parsons Brinckerhoff, added: 'We still await measures on how we can increase the number of young people taking STEM subjects.'

Mike Putnam, Skanska UK president and CEO, said: 'We have to improve training, recruit people with the skills relevant to new technologies and work hard to build a much more diverse and inclusive workforce.'

HM Treasury put politics ahead of sustainability, says committee report

The Treasury has been accused of putting short-term political priorities ahead of long-term sustainability and of 'riding roughshod' over departments by cancelling their environmental policies.

A new report by the parliamentary Environmental Audit Committee urged the Treasury to 'green check' its future decisions because its current approach is increasing costs to the economy and harming investor confidence. 'The Treasury is highly influential and uniquely placed to ensure the whole of government works to promote sustainability, but we have seen considerable evidence that it fails to do this,' said the committee's chair, Mary Creagh MP.

She added that it tended 'not to take full account of the long-term environmental costs and benefits of decisions, which would reduce costs for taxpayers and consumers in the long run'. By cancelling environmental programmes 'at short notice with no consultation', the Treasury cost businesses and the taxpayer tens of millions of pounds, according to the *Sustainability and HM Treasury, Fifth Report of Session 2016–17*.

The UK Green Building Council has called for the Zero Carbon Homes policy, cancelled in July 2015, to be reinstated. 'Its scrapping was an example of politically motivated policy-making. It showed an irresponsible disregard for the steps we need to take to tackle climate change, and overlooked years of investment and preparation made by thousands of companies,' said campaign and policy director John Alker.

BEIS 'tried to bury bad news' about smart meters

The government's smart meter rollout programme has hit further trouble with the revelation that predicted savings for energy consumers will be considerably lower than previously claimed.

A cost-benefit analysis of the scheme was produced by the Department for Business, Energy and Industrial Strategy (BEIS) in August, but the results were not made public until 10 November, two days after the US presidential election – prompting accusations that the government was burying bad news.

The analysis showed that the annual household dual-fuel energy bill will only fall by £11 by having a smart meter fitted, less than half of the previous estimate of £26. The government also underestimated the cost of setting up the smart meter network, which is now expected to cost £54m more than the initial £11bn forecast.

Energy suppliers have asked for an 'urgent' review of the timetable of the programme.

'This is a classic case of trying to bury bad news,' said David Frise, head of sustainability at the Building Engineering Services Association (BESA). 'The whole premise of smart meters is flawed.

'The danger is that what will actually be rolled out is a new generation of "dumb" meters that will simply help energy companies cut costs and improve their profits by doing away with physical meter reading and estimated bills.'

Housebuilders predict 28% growth

Despite underlying concerns over Brexit, rising material costs and skills shortages, housebuilders expect their market to grow by 28% over the next five years.

They are increasing investment to keep pace and most have put five-year plans in place, with spending – on average – rising by 17% per year, according to the second annual Lloyds Bank Commercial Banking report on the UK housebuilding sector.

The sector also has ambitions to create more than 70,000 jobs in the next five years.

In brief

GOVERNMENT BACKS 'SMART' ENERGY SYSTEM

The government and energy regulator Ofgem have launched a 'call for evidence' to back plans for a smarter energy system.

The Smart Power consultation is seen as the first step towards creating a system that – according to the National Infrastructure Commission – could benefit industry and consumers by up to £8bn a year by 2030.

'Peaks and pressures on the national grid are set to rise and much greater system flexibility will be required to ensure generation and demand are more efficiently matched,' said Ofgem.

BDP WINS HOUSE OF COMMONS CONTRACT

Design practice BDP has been appointed to head up the design, master and town planning, decant and relocation planning, design management and conservation design for the Northern Estate of the House of Commons. The contract is valued at between £15m and £25m for the estate work – which includes the Norman Shaw buildings, 1 Derby Gate and 1 Parliament Street – and completion is due by the early 2020s.

LOW CARBON PUSHES COAL OFF THE POWER GRID

More than half of the UK's electricity was generated from low carbon sources earlier this year, a new study has found.

Research from power station operator Drax found that electricity from 'low emission' sources peaked at 50.2% between July and September; the overall contribution of low carbon sources was just 20% in 2010. It also revealed that 5 May was the first day since 1881 that the UK burned no coal at all to produce electricity.

Drax's quarterly report, produced with Imperial College London, showed that in the third quarter of 2016 – 'for the first time' – more than half of the UK's electricity was generated from low-carbon sources. Nuclear provided the largest share (26%), renewables a further 20%, and the UK has increased generation from wind and solar six-fold since 2010, with biomass rising to 2GW from a standing start.

Lack of diversity is bad for your profits, delegates told

Women, minorities and disabled under-represented in building engineering

Building services firms are missing out on business opportunities because their workforces are not diverse and inclusive, experts claim. The building engineering industry is behind on all the major national demographics, speakers told a seminar organised by the Building Engineering Services Association and the Electrical Contractors' Association at London South Bank University – and it will struggle to replenish an ageing workforce.

The number of women engineers has fallen by 5,000 in the past 12 months, according to the campaign group Wise, while

OLLYY / SHUTTERSTOCK

the Office for National Statistics reports that just 8% of British engineers are women. Wise chief executive Helen Wollaston said firms need to work harder to attract and retain women, pointing out that 45% of female graduates in engineering and technology subjects do not join the STEM industry, while 70% of male graduates do.

Just 11% of the construction industry workforce is female; only 5% is registered disabled; and black/ethnic minorities account for just 5.7% of workers. A 'macho culture' can make it hard for LGBT people to feel welcome, while those from different religious backgrounds often feel alienated and excluded, the seminar heard.

'Diverse companies are more profitable,' said Danna Walker, founder of social enterprise Built By Us and former chair of Architects for Change. 'They react more quickly and creatively to big changes in their markets, and new people bring a different perspective – and spot gaps – that can lead to new business.'

RIGHT ROYAL REFURBISHMENT

The proposed 10-year programme to refurbish Buckingham Palace will cost £369m and involve wholesale replacement of the heating system and electrical wiring.

Under the controversial taxpayer-funded plan, 20 miles of heating pipework, 100 miles of electrical cabling, 2,500 radiators, 5,000 light fittings, and 6,500 electrical sockets will be replaced.

The refurbishment requires parliamentary approval to go ahead, but is expected to receive the green light in April, with the aim of completing the work by 2027.

KEATTIKORN / SHUTTERSTOCK

Wellbeing knowledge gap still wide

More research is needed to identify factors affecting health and wellbeing (H&W), delegates were told at a conference hosted by UCL Institute for Environmental Design and Engineering, CIBSE Home Counties South East and CIBSE Natural Ventilation Group.

The speakers highlighted the importance of H&W and the need to introduce new models for an integrated design approach. CIBSE research manager Anastasia Mylona said: 'A key challenge is gathering quantitative evidence – H&W is affected not only by environmental factors such as humidity and air quality, but also by social, mental and physical aspects.'

Health and wellbeing was the focus of last month's BSRIA Briefing. Delegates were told that the industry will need to develop new skills to address this area.

Matthew Webster, head of wellbeing and futureproofing at British Land, said, typically, 90% of operating costs for building occupiers was spent on staff costs – making human wellbeing and 'happiness' crucial, particularly as it affects productivity.

There will be more coverage of the UCL/CIBSE conference in the January issue of *CIBSE Journal*.

CHEERS! OLD BREWERY TO BECOME NEW BUILDING SKILLS HUB

Atkins has received planning permission to transform a derelict brewery into a £100m education hub for construction and the built environment at the University of Wolverhampton.

The redevelopment of the former Springfield Brewery site includes the creation of a new School of Architecture and Built Environment, alongside a hub for the Elite Centre for Manufacturing Skills.

Atkins' lead architect, Helen Newman, said the design would 'retain, protect and celebrate the existing buildings, while clearly expressing the new, modern interventions'.

The scheme promises to bring the external spaces of the former brewery back to life, transforming them into 'a vibrant, central, shared courtyard space for all of the partner hubs'.

Radical change needed for UK to achieve heat pump targets

One million installations per year will need 'financial levers'

VERENA MATTHEW / SHUTTERSTOCK

The government's aim for 200,000 heat pumps to be installed in the UK by 2020 will not be possible without a radical shift in the market – plus a revision of government policy – industry experts told UK Construction Week.

Around 16,000 heat pumps are currently installed in the UK every year, but a new report from the Committee on Climate Change has proposed that this figure should rise to almost 50,000 between now and the end of the decade – and to one million a year thereafter.

Only members of the Microgeneration Certification Scheme (MCS) can certify domestic heat pumps so that end users can claim payments under the Renewable Heat Incentive, and the number of installers in the scheme has fallen to just 800 in recent months. Gas boilers continue to dominate the UK domestic market, with around 1.6 million installed every year by approximately 120,000 registered heating installers.

Phil Hurley, managing director of heat pump manufacturer NIBE, called for a thorough revision of the MCS 'because there are simply not enough installers to do the work'. He said it needed to focus more on delivering installations and less on consumer protection.

Phil Jones, past chair of the CIBSE Energy Performance Group, said British people tended to favour boilers and hot radiators: 'There is a big social education job to be done in explaining the benefits of low temperature heating.' Meanwhile, Tim Rook, technical director at the Building Engineering Services Association, said it was hard to envision how such a dramatic increase in installations could be achieved without greater financial levers. He said these could be incentives for installers and end users, or a fairer distribution of tax and levies on fuels.

Industry mourns BSRIA expert Reginald Brown

BSRIA's head of energy and environment, Reginald Brown, died last month after a short illness. He was 63.

Brown took up the post four years after joining the institution in 1989. A popular and highly regarded expert in his field, his recent work included photovoltaic applications, heat pumps, water conservation, sustainable development, low carbon solutions and environmental guidance.

Brown gave expert input to both the Water and Building Regulations advisory committees, assisted the HSE on legionella, and authored and contributed to several guidance publications for CIBSE and BESA in the areas of pipework installation, heat pumps, and combined heat and power. He wrote many BSRIA guides, including: *Legionnaires' disease – Operation and maintenance log book*; *Water treatment for closed heating and cooling systems*; and *Heating controls in large spaces*.

A chartered engineer, Brown was an assessor for the Energy Technology List (Carbon Trust) and a past-chair of the education committee of the European Heat Pump Association.

Julia Evans, BSRIA chief executive, said: 'Reginald loved what he did – it was his passion and hobby as much as it was his work. The industry will be a poorer place for his passing.'

Architects lack focus on 'buildable details'

Only 31% of contractors are satisfied with the way they work with architects on projects, reveals a report from the Royal Institute of British Architects (RIBA).

Large numbers said architects lack 'commercial understanding' and are not capable of tempering their designs to reduce complexity and match commercial drivers. Too many, the report says, are focused on 'visualisations and not buildable details', or can't match their technical detailing to fast-paced construction programmes.

RIBA's ambassador for collaboration, Dale Sinclair, said the results were 'disappointing, but no surprise', adding that part of the problem was architects being novated to contractors late in the process. 'Novated architects need to disclose more detail on design risks with the contractor's perspective in mind,' he said, adding that architects needed to get better at communicating designs so the project team could make 'more considered decisions about cost and risk'.

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Lift Symposium: call for papers

The seventh Symposium on Lift and Escalator Technologies will be held on 20 and 21 September 2017.

The University of Northampton, CIBSE Lifts Group and the Lift and Escalator Industry Association (LEIA) are inviting papers and abstracts for submission. Speakers – including industry experts, academics and postgraduate students – will have an opportunity to present peer-reviewed papers. For details, and to submit an abstract, visit **www.liftsymposium.org**

SLL Masterclass returns

The third of the new Society of Light and Lighting knowledge series – focusing on human responses to light – will be held at the Library of Birmingham on 26 January 2017.

Speakers include Chris Wilkes (Holophane), Iain Macrae (Thorn), Helen Loomes (Trilux) and Roger Sexton (Xicato). Within the new series, speakers will discuss case studies and current research relating to psychological, physiological, emotional, cultural and visual responses to light in a variety of environments.

Get a slice of Carbon Bites

Six new 'Carbon Bites' articles have been produced from the CIBSE Young Energy Performance Group (YEPG) mini-lecture series.

The talks were held between March and May on topics such as: district heating; metering; controls; occupant behaviour; post-occupancy evaluation; building controls; and the legal background to energy performance. They can be found at **bit.ly/2fVSR1L**

For details of YEPG events visit **bit.ly/2fujo7E** and follow @CIBSEyepg on Twitter.

Nominations for officers, board and council members

- **Board should include representation from different sectors of the building services industry**

New CIBSE officers, board and council members are elected each year to take office from the AGM in May.

Officers and elected board members serve on the board, which is the Institution's governing body. It is made up of the seven officers – president, president elect, three vice-presidents, honorary treasurer and immediate past president – and five elected members.

The council is a much larger consultative body that advises the board on Institution policy.

It mainly comprises representatives of the regions, societies, groups and standing committees, and has a number of places for elected members, who serve a three-year term. Two corporate members and one non-corporate member can be elected each year.

The board is required to nominate candidates for all officer and board-member vacancies arising at the AGM. It is advised by a nominations panel and all sections of the Institution are invited to suggest candidates for consideration.

The panel gives careful thought to its recommendations and seeks to reflect Charity Commission guidance by nominating a range of candidates with the skills and experience required to fulfil the board's role as the governing body of a significant registered charity.

It also seeks to ensure that the board includes a balance of representation from different sectors of the industry.

Nomination rules

Members of the Institution are entitled to nominate additional candidates for vacancies arising in May 2017, in accordance with the following rules, set out in the Royal Charter, By-Laws and Regulations:

Fellows, Members, Associates and Licentiates may submit nominations for the offices of president elect, vice-president and honorary treasurer, and for elected members of the board. The candidates must meet the qualifying criteria, and must be supported by 10 nominations from Fellows, Members, Associates and Licentiates.

Fellows, Members, Associates and Licentiates may also nominate individuals from those grades for membership of council. Graduates, Companions and Affiliates (including students) may nominate individuals from those grades for membership of council. Candidates for council must meet the qualifying criteria and must be supported by five nominations from members in the appropriate grades.

Any such additional nominations must be made in writing to the chief executive, to be received at CIBSE headquarters by 31 January 2017, together with the written consent of the nominee to accept office if elected. The names of those making nominations will follow the name of the candidate on the ballot paper, should a ballot be required.


Doug Oughton was awarded the Gold Medal

Oughton takes highest honour at President's Awards

Heriot-Watt and Ulster universities also recognised

Former CIBSE president, Doug Oughton Hon FCIBSE, was awarded a CIBSE Gold Medal – the highest award of the Institution – at the President's Awards dinner in October.

Oughton – the 31st recipient of this award for exceptional services to the Institution – was recognised for his contribution to CIBSE over almost 50 years, especially his work on skills and professional development within the building services profession.

Alec Moir gave the citation, highlighting Oughton's achievements in a career that dates back to the 1960s and started with Oscar Faber. He continued as director of Oscar Faber and Faber Maunsell until his retirement in 2004, but he continues to work for its successor company, Aecom.

His links with CIBSE and the profession are also notable: he became a Fellow of the Royal Academy of Engineering, was chair of the European Intelligent Building group and of CIBSE Patrons, and served as CIBSE President in 2002/03. Moir said: 'With that outstanding career and contribution to bringing the engineering community together to ensure they speak with a single coherent voice on education and skills, for the benefit of future generations of engineers and technicians, we thank you and congratulate you on your well-deserved Gold Medal.'


CIBSE President John Field gave Heriot-Watt's Dr Kirk Shanks the Hays President's Prize


Ann Johny won the CIBSE Undergraduate Award


Ulster University's Jayanta Mondol and Mervyn Smyth (centre) received the Happold Brilliant prize from Happold Trust chair Gavin Thompson and John Field

Other awards presented on the night included:

Hays Building Services President's Prize

Ann Johny, of Heriot-Watt University, won the CIBSE Undergraduate Award and a prize of £500, for her work on 'Optimising double-skin façades for high-rise buildings in the UAE'. The award, sponsored by Hays Building Services, is designed to encourage students to develop their potential and aim for excellence. It is open to those in their final year of a building services course accredited by CIBSE, and recognises their academic achievements.

A trophy was also presented to Heriot-Watt University in acknowledgement of its achievements.

Happold Brilliant Award

This recognises excellence in the teaching of building services engineering and, this year, the award went to Ulster University. It was presented by Gavin Thompson, chair of the Happold Trust, to Dr Jayanta Mondol and Dr Mervyn Smyth, who accepted it on behalf of the university.

Bright students shine at York light festival

Four famous York landmarks were lit up with designs by local school pupils as part of the Society of Light and Lighting's (SLL's) involvement with the Illuminating York festival.

Students from York College, Fulford School, St Wilfrid's RC Primary School and The Mount School took part in SLL workshops, where they received hands-on lessons about the art and science of light. The winning design – chosen by a panel of judges – was then used to illuminate St Leonard's Hospital, St Michael Le Belfrey church, Exhibition Square, and the Multangular Tower in the Museum Gardens.

The SLL workshops, called 'Pockets of light', demonstrated the science behind lighting and its potential to create artistic designs. The displays were part of the society's contribution to Illuminating York, during which landmarks around the city are lit by artistic lighting designers, allowing visitors to experience them in a new way.

The project was held on the anniversary of the Night of Heritage Light, when the SLL lit up nine UK Unesco World Heritage Sites.

Jeff Shaw, the society's president, said: 'Light is an important part of how we experience the world around us and, by working with the students to light their own city, we are also helping them to think differently about the spaces around them.'


St Leonard's Hospital

New members and fellows

FELLOW

Calder, Keith
Sunbury-on-Thames, UK

Gay, Carl Stephen
BT District HCMC, Vietnam

Impey, Steven Brian
Leamington Spa, UK

Lau, Chi Chuen
Kowloon, Hong Kong

McKeag, Sean Michael
Dubai, UAE

McNee, Owen
Glasgow, UK

Murphy, Edward
Sheffield, UK

MEMBERS

Ali, Muhammad
Doha, Qatar

Chan, Leung Kit
Tseung Kwan O, Hong Kong

Chan, Man Hin
Kowloon, Hong Kong

Chan, Chi Kin
Kownloon, Hong Kong

Chan, Chi Wai
Tuen Mun, Hong Kong

Chau, Sai Kit
Kowloon, Hong Kong

Cheung, Siu Lung
Quarry Bay, Hong Kong

Chu, Man Yan Mianne
Kowloon, Hong Kong

Ciprani, Danilo
Oldham, UK

Dudhaiya, Vipul
London, UK

Elsayed, Mohamed Mansour Mohamed
Qatar, Qatar

Flegkas, Vasileios
London, UK

Fletcher, Mark Stuart
Warsaw, Poland

Fok, Alan
St Ives, Australia

Fok, Ching Chuen
Tsing Yi, Hong Kong

Fumagalli, Pietro
London, UK

Gamage, Asanka Nirmal
Pannipitiya, Sri Lanka

Geronimo, Rochelle
Makati City, Philippines

Ho, Ngar Yee Eunice
NT, Hong Kong

Lam, Kwan Ngai Kendrick
Tusen Wan, Hong Kong

Lam, Tik Hang
Tseung Kwan O, Hong Kong

Law, Ka Yee
NT, Hong Kong

Lee, Ryan
Heatherton, Australia

Lee, Alex
Baulkham Hills, Australia

Li, Man Wui
Kwai Chung, Hong Kong

Lo, Wai Keung Wilson
Quarry Bay, Hong Kong

Ng, Wai Yin
Ma On Shan, Hong Kong

Ng, Tsz Ho Roger
Kowloon, Hong Kong

Nunes da Silva, Eduardo Pedro
Maidenhead, UK

Palmer, John
London, UK

Ramponi, Rubina
London, UK

Sing, Man Kin
Kowloon, Hong Kong

Thow, Nicol
Sydney, Australia

Wong, Wai Lung
Kowloon, Hong Kong

Yiu, Ting
Tseung Kwan O, Hong Kong

Yuen, Hon Kit Keith
New Territories, Hong Kong

Yuen, Vanon
Tuen Mun, Hong Kong

Yuen, Lai Ching
Tuen Mun, Hong Kong

ASSOCIATE

O'Neill, Declan
Tyrrelstown, Ireland

LICENTIATE

Allison, Luke
Berkshire, UK

Carr, Joshua
Oxford, UK

Coldrey, Tom
Plymouth, UK

Fannon, Greg
Salford, UK

Heavey, Declan Patrick
Southampton, UK

Marshall, Ryan
Edinburgh, UK

Sweeney, Keir
Bristol, UK

Whitehead, Brett
St. Albans, UK

Yuile, Christopher
Alveley, UK

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- Direct driven fans with EC motors
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- Digital compressors
- Integrated control system
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A TIGHT CALL

Airtightness testing of new dwellings and non-residential buildings has become routine since the adoption of carbon dioxide emissions requirements in the Building Regulations. **Hywel Davies** reviews the criteria for testing and for testers

Airtightness testing first featured in the Building Regulations in the 2002 edition, which referenced CIBSE TM23. It was a way of showing compliance with a requirement to limit heat loss through the building fabric.

The move to a whole-building calculation method in the regulations in 2006 – a consequence of the original Energy Performance of Buildings Directive – introduced mandatory requirements for airtightness testing. These have been adjusted in the subsequent 2010 and 2013 revisions of the regulations and in the associated statutory guidance given in Approved Documents (ADs) L1A and L2A. Building Regulations set out legal requirements, while ADs offer secretary of state-approved guidance on how to meet them.

The term 'airtightness' is widely used in practice, but the more precise 'air permeability' is employed in the ADs. The air permeability of a dwelling or building can have a significant effect on the carbon emissions calculation, and on ensuring adequate purpose provided ventilation. For anyone undertaking pressure testing to measure the air permeability of a building in connection with the Building Regulations, Regulation 43 'Pressure testing' is required reading. A key requirement is that the pressure test is carried out on any building within the scope of Part L, 'in such circumstances' and 'with a procedure approved by the secretary of state'. Notice of the test results shall be given to the local authority within seven days of the test.

The procedure currently approved for pressure testing is given in the Air Tightness Testing & Measurement Association (ATTMA) publication *Measuring air permeability of building envelopes (dwellings) October 2010 issue*, and *Measuring air permeability of building envelopes (non-dwellings)* and specifically uses the method that examines the envelope area. The preferred test method has trickle ventilators temporarily sealed rather than closed.

> Given that the air permeability value calculated from the pressure test will be used to work out the carbon emissions rate, this is a significant number

Building Control Bodies (BCBs) should also be given evidence that test equipment has been calibrated within the previous 12 months, using a UKAS accredited facility. Section 4 of the ATTMA publication describes the approved manner for recording the results and the data on which they are based.

The AD makes clear that testing must be carried out in accordance with the ATTMA procedure. On that there is no latitude, it is a clear requirement. But there is latitude over who undertakes the testing. There are currently two authorised schemes with which pressure testers may be registered: the ATTMA one or the Independent Airtightness Testing Scheme (iATS) – but there is no requirement for a tester to register with any scheme.

Air pressure testing results can be submitted to a BCB in two ways. Regulation 43(4) authorises BCBs to accept a certificate from a member of one of the two schemes authorised by this regulation, stating that the pressure testing of a building has been carried out in accordance with the procedure approved by the secretary of state. Alternatively, someone who is not a member of an authorised scheme may carry out testing. Instead of a certificate, they must submit a notice – under regulation 43(2) and (3) – setting out the results of the test and the data on which the results are based. A BCB may take account of the information supplied in the notice in coming to its decision, both on whether the test results are a true reflection of airtightness in a building, and that the approved procedure has been followed.

Airtightness test

BCBs may also take account of any training undertaken by the tester to show they are sufficiently skilled to carry out the test, and details of how and when calibration of test equipment has been carried out. Ultimately, it is for the BCB to determine whether or not they consider the report submitted under regulation 43(3) satisfactory.

The air permeability value calculated from the pressure test will be used to work out the carbon emissions rate. A BCB that questions the air permeability figure or test procedure may also question the carbon emissions calculations that rely on the air permeability test result.

Readers engaged in aspects of pressure testing may wish to review the AD, Regulation 43, and the associated guidance to ensure they are fully aware of the requirements and the approved methodology, as well as the requirements to notify Building Control.

● **HYWEL DAVIES** is technical director at CIBSE **www.cibse.org**

BREAKING BIM

The millenials are coming, says Hoare Lea's ***Ben Roberts***

What a year. Blackstar David Bowie departed Earth while everything was comparatively hunky-dory. We've sadly said goodbye to many great cultural icons in 2016 and, to cap it all, you now have to do BIM on all government-owned projects too. But there is hope for a better, friendlier, more collaborative, compassionate and holistic future, with a new breed of construction professional: millennials. These are people who started work after the dotcom boom, and who now comprise almost 50% of the workforce in the UK. They have brought to the construction industry a hunger for more exciting ways of designing, building and operating built environments.

In 2016, most businesses had some exposure to BIM and, generally, are now dealing with it at the core of their business. A few years ago, BIM was about technology and process, but a more fundamental aspect has come to the fore: culture.

While it is possible to learn 'how to BIM', you'll struggle to keep up with the pace of change unless you grasp the underlying passions and attitudes that motivate the move towards faster access to information, and to outsourcing mundane tasks to a more appropriate resource (that's computers, by the way). So how does one understand a different culture? A good place to start is the modern world.

We are constantly exposed to open tools and decentralised movements, such as smartphones, tablets, online banking, Netflix, electric cars, social media, Airbnb, Uber, Google, eBay, self-service tills – even doors and stairs that do the work for us. But, somehow, we feel this can't be applied to our working lives. Changing a generations-old culture is proving an uncomfortable experience, but the best way to survive is to look at how current tools can help us all to improve our lives, and work from there. Of course, some computer stuff is still the realm of programmatically gifted *Star Trek* enthusiasts – but it's no longer an exclusive club.

A thread that has exploded in 2016 is immersive technology, which brings computer models to life. It's a very clear and easy way to see around models without having to be a Revit guru.

This month, the CIBSE Digital Steering Group asked me to address an issue that is at the heart of this whole column series – removing the stigma of BIM and digital, and encouraging everybody to find out how they can benefit from computers/data, even if they 'don't do computers'.

Now that BIM is becoming the standard form of project delivery, I'm hearing fewer conversations about 'why?', 'what's the point?' or 'it's just a fad'. We appear to have graduated to a reluctant acceptance of 'how do we manage this thing then?'. There are some decent resources to guide you through this – check out the new CIBSE Digital Engineering series, now available online, and the upcoming CIBSE BIM Roadshow.

But if you're still wondering 'why?', it's because BIM is the first step towards an inevitable future of collaboration, where technology is a helpful part of our team, and processes are clear, simple and transferable.

BEN ROBERTS MCIBSE is BIM delivery leader at Hoare Lea and a member of the CIBSE BIM steering group

Panellists discuss the impact of legislation on building services engineers

SMART MINDS

Health and wellbeing, retrofitting and performance data were key themes at this year's CIBSE Building Performance Conference. **Ewen Rose** and **Liza Young** report on the event

> The data is there to allow full witness testing of a building post-commissioning; the issue is having the processes to crunch that data and make it useful

Building services professionals will soon be contractually bound to offer analysis of energy performance data to clients, according to speakers at the CIBSE Building Performance Conference.

A theme throughout the first day at the QEII Centre in London was frustration around digital data. Speakers said the availability of huge quantities of building performance information is key to solving the 'performance gap' – although gathering it efficiently and using it for meaningful analysis continues to elude large parts of the industry.

Several data specialists urged engineers to be mindful that – while 'smart' technology is widely available – it is not always a 'smart person' who gets the job of operating the system once the building is occupied, so better and easier user interfaces are crucial.

Casey Cole, of Guru Systems, said engineers would soon be legally liable – and their personal indemnity (PI) insurance would come under threat – if they fail to deliver good-quality, usable performance data to their clients. 'Digital can close the information loop and help clients procure better, and then measure to ensure they get what they ordered,' he said. 'The key is to take the data and feed it back into the design process – but, the problem is, we are not paid to stick around for long enough to close the information loop.'

Alex MacLaren, of Heriot-Watt University, added that engineers had a 'professional responsibility to pay more attention to the asset we create, and that means using the data more intelligently'. Current systems for evaluating data were 'cumbersome', but would improve, she said.

Value

'We need to demonstrate better value to the client,' added MacLaren. 'The data can do this if we develop a really brilliant app that shows clearly, for example, how well the building is doing and how much it is saving the user.'

Clients can now measure almost anything in their building very cost effectively, but turning that data into something useful is proving more difficult, said Mike Darby, of Demand Logic. 'The data is there to allow full witness testing of a building post-commissioning; the issue, though, is having the processes to crunch that data and make it useful. The challenge is to do this quickly enough so the problems don't languish.'

This makes the availability of large amounts of performance data a threat as much as an opportunity, according to the conference session chair, Les Copeland, of WSP.


Marine Sanchez, of Enhabit, talks about retrofitting


Max Fordham looks back on his 50 years in the industry


Debbie Hobbs calls on the industry to design for performance

'Digitisation is creating headaches because we haven't fully understood how it translates into good building operation,' he said, before adding that the industry would now have to deal with greater scrutiny. 'That will bring us trouble to start with, as clients will see exactly where the problems are. However, in the long term, it will allow us to design better.'

David Matthews, of Hoare Lea, said data needs to be standardised so proper comparisons can be made, adding: 'At the moment it isn't, so we are not getting the trends we expected.' Meanwhile, Mat Colmer, of Digital Catapult, believes focusing on what people need – rather than what they want – makes for a good digital strategy. 'Collecting too much data can slow you down because you still have to crunch it,' he said.

Colmer gave examples of technologies that show the way the industry will change, including: Microsoft's HoloLens, which blends holograms with the real world; MX3D, which allows industrial robots to 'draw' metal structures in the air; and Blockchain – a coding technology that removes the middleman from monetary transactions. 'The transaction itself is the verification process, potentially dispensing with the many intermediaries in a supply chain,' said Colmer. 'These technologies will pave the way to what will happen in the future.'

Performance gap

Legal & General Property's sustainability manager, Debbie Hobbs, said the industry is not designing for performance. The building engineering supply chain did not understand how buildings were operated, she added, so was failing to adapt its designs and systems to the end user. The project process was flawed and facilities management was procured at the lowest cost; as a result, built assets were undermined because of the 'very low skills base' involved in their operation, Hobbs said.

Neil Pennell, head of engineering and design at Land Securities, said building operating problems are at a very basic level, with energy meters being wrongly calibrated and badly installed, and control systems failing to perform even basic functions.

'If the information we get from our meters is wrong, then the information we send to tenants for billing is wrong, and the energy performance data is wrong,' he said. 'As buildings become increasingly sophisticated, you can have hundreds of meters all delivering inaccurate data.'

Pennell added that the quality of smart technology 'has ramped up, but the training of building operators hasn't', and that many controls engineers 'don't know how to read a psychrometric chart, so can't properly set up the control systems for the building. They just turn things on and hope.'


CIBSE President John Field wants more diversity in the sector

CIBSE President John Field said the industry would need to recruit a more diverse and inclusive workforce to deliver better building performance. 'If there isn't a performance gap, there is definitely a skills gap,' he said. 'We are currently only fishing in about 10% of the [population] pond – and do we need medics to address the issue of wellbeing in buildings?'

In the opening session, Atelier Ten's Patrick Bellew said smart metering could help to close the performance gap, 'but the process needs to be there to make sure the knowledge produced by the meters is usable'.

Collaboration for better performance

On day two, Neil Lewis and Jonathan Purcell, of Waterman Building Services, explained how the team behind Liverpool's Everyman Theatre worked together to create the striking, naturally ventilated building.

The project team was motivated by the client's positive attitude. 'For them, the theatre is not just a building – it's a home,' said Purcell. 'Developing a building knowing they would have to have it for 30-40 years makes a very motivated client – and that's infectious for the design team.'

But to test how truly collaborative the team is, tell the architect you want a 16m^2 hole in the ceiling, said Purcell. 'I do not remember the team asking whether something can be done. They only asked: how can we do it?'

Adapt Low Carbon Group CEO, John French, said a year and a half was spent in

design workshops and design development for the University of East Anglia's Enterprise Centre. 'Our ethos was "no surprises". We all worked together as equals and shared information, positive and negative,' he said.

Ted Pilbeam, building services and sustainability director at VolkerFitzpatrick, gave a presentation on the firm's CIBSE award-winning training programme, which was rolled out to the 150-strong workforce. The final programme morphed into an interactive event, said Pilbeam, adding: 'Gone are the days of old-fashioned practical completion – commissioning and environmental testing start when the painter puts down the brush.

'At handover, the client must be ready to operate the building, which needs to perform to its required function. Without good collaboration that would not happen.'

Refurb and retrofit

Environmental adviser at the National Trust, Keith Jones, said there needed to be less focus on new-build properties and more on older building stock – especially as the UK has a very high percentage of pre-1919 housing.

Among the 29,000 properties run by the charity is an 18th-century Welsh mansion, Plas Newydd, that – until recently – used 1,500 litres of oil a day. Jones explained that the trust saved 40% on energy costs simply by explaining to staff how things worked. It also allocated responsiblity for mundane – but important – processes such as changing the clock back on the building management system (BMS).

Engaging building users is vital, he added, because a fancy BMS won't help if someone leaves the back door open. 'We invested £29,000 in a heating system, and someone invested 50p in a wedge.' National Trust site managers have a key performance indicator linked to energy consumption of their site, so they are incentivised to lower it, Jones said.

Patrick Bellew – smart meters could help close the performance gap

Munish Datta, M&S head of Plan A and facilities management, said the M&S estate is almost 40% more efficient since its sustainability programme started in 2006, with 90% of the savings coming from retrofit.

'We are still finding low-hanging fruit,' he said. 'We need to keep the programme of deep retrofit alive, year on year, and keep appraising the market for innovative products.'

Marine Sanchez, of Enhabit, added that retrofitting is best done once – and done well. 'The lifetime of our buildings means that what we're doing right now will impact on how much energy they are going to use in the next 80 years.' She said carrying out deep retrofits could reduce the global risk of building-related carbon lock-in.

The message from speakers was clear: when designing new – or retrofitting old – think long term. As French pointed out: 'We need to ensure buildings are net generators of energy, not consumers of energy, and that they are assets in tackling climate change.' CJ

HEALTH AND WELLBEING

The engineering sector needs to measure building performance in terms of human health and wellbeing – rather than purely through technical data. That was the opinion of several speakers, who urged engineers to consider the impact of buildings on broader social and environmental issues.

'We are starting to think bigger as an industry,' said Andy Ford, professor at London South Bank University, who believes the sector's value to society could be expressed differently. 'Excess cold is costing the NHS £1bn a year; 2.9 million people live in fuel poverty; and we suffer 15,000 excess winter deaths. That is something we could sort out.' He called for every building to be at PassivHaus standard by 2050, and for home energy efficiency to be 'a national infrastructure challenge'.

Matt Fulford, of Inspired Efficiency, said human health and productivity aspects of building performance would be a better way of assessing the value of what engineers deliver. If a building performs well, he added, it contributes staff-retention savings of £18 per m² per year, and sickness reduction of £26 per m² per year. A 5% rise in productivity, as a result of a good indoor environment, is estimated to be worth £307 per m² per year.

The industry also has a key role to play in protecting building occupants from the effects of rising air pollution, said Gary Fuller, senior lecturer at King's College London. On PM2.5 airborne particulates, he said the UK was meeting limits set by the EU, 'but they are too relaxed' and not as recommended by the World Health Organization, which says there is no safe limit for this kind of pollutant.

The ability of people to measure air quality and other factors that affect their health is creating a demand for better indoor environments, according to Alan Fogarty of Cundall, which has signed up to the Well Building Standard. To meet the standards, building managers need to be able to reduce the concentration of CO_2 in a space to 800ppm and keep ozone and volatile organic compounds (VOCs) at safe levels.

CONGRATULATIONS TO OUR 2017 SHORTLIST

Building Performance Training Programme Award

- BREEAM Associate - BRE Academy
- GATES Training & Development Programme - Hurley Palmer Flatt HR Department

Building Performance Consultancy of the Year (up to 100 employees)

- Beverley Clifton Morris (BCM)
- CES Engineering Sustainability
- Crookes Walker Consulting
- Elementa Consulting
- FairHeat
- SVM Consulting Engineers

Building Performance Consultancy of the Year (101-1000 employees)

- Hoare Lea
- Max Fordham
- Red Engineering Design

Building Performance Consultancy of the Year (over 1000 employees)

- AECOM
- Atkins
- WSP - Parsons Brinckerhoff

Collaborative Working Partnership Award

- Birmingham New Street Station - Atkins / Network Rail
- Integrated Energy Management and Innovation with Broadgate Estates - George Birchall Service / Broadgate Estates
- RNLI Porthdinllaen - Hoare Lea
- Working together to cut energy costs - NG Bailey

Energy Management Initiative Award

- Knowledge-based Energy Management of Swire Properties Hong Kong Portfolio - Swire Properties
- Project OREO - Arup
- Somerset House - Cynergin
- UK Managed Portfolio - M&G Real Estate

Facilities Management Team Award

- AA Facilities Management Team - CBRE Global Workplace Solutions
- Aon London Centre - CBRE Global Workplace Solutions
- London Portfolio - Broadgate Estates
- PDO Integrated Facilities Management (PDO IFM) - Carillion Alawi LLC / Petroleum Development Oman (PDO)
- University of Bradford's Low Carbon Estate - University of Bradford - Department of Estates and Facilities

Energy Efficiency Product or Innovation of the Year

- Climate Wizard CW80 - Seeley International
- NVHR+ Hybrid Natural Ventilation Heat Recycling Unit with Heating Pod - Breathing Buildings
- Photovoltaic-powered VRF system - Gree UK
- Sentinel Kinetic Advance - Vent-Axia

Energy Saving Product or Innovation of the Year

- ADAMM – Asset Database for Auditing and Maintenance Management - Building-Performance
- Cool-phase Hybrid® - Monodraught
- ECLYPSE Connected System Controller - Distech Controls
- Guru Pinpoint - Guru Systems
- Hevasure Monitoring System - Hevasure
- Photovoltaic-powered VRF system - Gree UK

Project of the Year - Commercial/ Industrial

- Jaguar Land Rover Engine Manufacturing Centre (JLR EMC) Module 1A - Ove Arup & Partners
- Project Jewel - Aon
- Tower 42 Lift Refurbishment - BNP Paribas Real Estate / SVM Associates
- West Cambridge Data Centre - Arup

Project of the Year - International

- Bay Centre 6 Stars - Mirvac
- Breaking the 6 Star NABERS Barrier - Energy Action
- DPR Net Positive Energy San Francisco Office - Elementa Consulting, Member of Integral Group

Project of the Year - Leisure

- Hawkchurch Resort & Spa by Darwin Escapes - CD International Building Services Engineers
- Hillsborough Leisure Centre - Sheffield City Trust
- Refurbishment of Main Kitchen of Fredericks Restaurant - TAG Catering Equipment

Project of the Year - Public Use

- Birmingham New Street Station - Atkins / Network Rail
- City of Glasgow College, Riverside Campus - Hulley & Kirkwood
- Edinburgh Centre for Carbon Innovation - Harley Haddow
- Five Pancras Square - Sweco
- Herefordshire Archive and Records Centre - Architype / E3 Consulting / Elemental Solutions
- Keynsham Civic Centre - Max Fordham
- Schoolhaus at Chalgrove Primary School - UK Energy Partners
- The Chancellors' Building, University of Bath - Hoare Lea

Project of the Year - Residential

- Tigh Na Croit - HLM
- Trafalgar Place - TUV SUD

Public sector projects made a strong showing in the entries for the 2017 CIBSE Building Performance Awards. **Alex Smith** joins the judges as they decide on the shortlist for this category – and 14 others – from a very diverse range of entrants

PUBLIC DISPLAYS OF AFFECTION

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SIG MECHANICAL & ELECTRICAL

The Chancellors' Building, Hoare Lea

Edinburgh Centre for Carbon Innovation, Harley Haddow

The shortlist for the 2017 CIBSE Building Performance Awards is one of the most diverse there has ever been, according to the industry experts who made the final selection last month.

Judges sifted through dozens of entries representing all areas of the building services industry. They remarked that the Project of the Year categories had attracted the broadest range of buildings they had seen – from single homes to heritage buildings and large estates.

'It's great to see some really small companies entering the awards,' said CIBSE Services managing director Rowan Crowley, 'and that should be encouraged.' The influence of data on the design and operation of buildings is also becoming more apparent in the entries, he added.

Of the four project categories, the Public Sector Project of the Year led the way with what the judges said was the most impressive set of entries. 'The strength of the field in the public sector is worth celebrating,' said Munish Datta. 'They've left the commercial people a little bit behind.'

The high quality of entries has not made judging easy. 'Usually, there's an obvious one or two projects. Here, there are at least three or four projects that you could pick as a winner,' said Datta. 'That's the mark of a really good field.'

'It's interesting that this is for public buildings,' said Sarah Ratcliffe. 'They are better than in the other building categories. It is interesting to see the drivers for good performance – for example, they are more likely to have Display Energy Certificates demanded of them.'

Atkins' Birmingham New Street Station

Across all project categories, Datta was gratified to see that more projects were considering the total energy usage in the building, not just regulated energy.

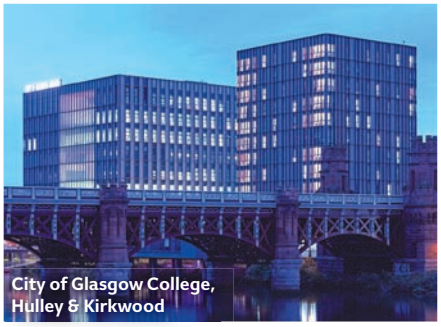
Mark Hawker agreed and noted more holistic designs among the entries. 'It is encouraging to see that the function of the architecture and IT have all been treated as one,' he said.

Sara Kassam was among the judges who

Five Pancras Square, Sweco


Keynsham Civic Centre, Max Fordham


Schoolhaus at Chalgrove Primary School, UK Energy Partners


City of Glasgow College, Hulley & Kirkwood


Herefordshire Archive and Records Centre, Architype, E3 Consulting and Elemental Solutions

commented on projects where architectural design quality had not been compromised for the sake of good performance. 'There has been more architectural-rich content in the entries; there seems to have been more focus on appearance this year.'

'There has been a continuation of the link between energy efficiency and beautiful buildings,' noted Bill Gething, while fellow architect Justin Bere said the two should always go hand in hand. 'Good architecture doesn't exist without good performance.'

Kassam reminded judges that entries showing solid principles of good building operation should not be overlooked. 'The routine elements done very well should be rewarded. It takes a lot of hard work to get a result,' she said.

Competition was fierce in the Building Performance Consultancy of the Year categories, with the award for firms with up to 100 employees being the most hotly contested. 'Generally, the submissions in this category were of a very good quality,' said David White. 'I was impressed with the original answers – and a lack of dross.'

'It was very close between the top two,' remarked Susan Hone-Brooks. 'I found it hard to separate them.'

The judges were looking for examples of consultants that went beyond the norm. As a client working for Sainsbury's, Hawker is in an ideal position to judge. 'The good companies are those that come up with the ideas and give you options. They don't just do as the client says,' he says.

Bere, meanwhile, was pleased to find examples of firms encouraging their engineers to be creative with their problem solving. He noted that some entries had demonstrated 'a lot more encouragement of independent thought'.

While the overall quality of entries was high, some contenders were handicapped by incomplete answers or missing performance data. Judges were particularly mindful of entries that were well written, but that may have lacked substance.

'Some of the best entries are simple and to the point,' said Datta, while others were deemed overlong and 'too wordy', and did not always answer the question.

Some of the entries didn't do justice to the quality of the buildings, according to Gething, who added: 'There was a great story there, but it hasn't always been explained well.'

The shortlisted entrants will have to wait until the new year to see if they have won. The awards night will also reveal the overall Building Performance Champion, and the judges have a tough task with a number of outstanding candidates. **CJ**

CIBSE BUILDING PERFORMANCE AWARDS 2017

Join the industry's best talent on awards night to see who will scoop the accolades. The showpiece event – on 7 February 2017, at London's Grosvenor House Hotel – will celebrate achievements across the built environment supply chain. Don't miss your chance to be there – book a table now on **www.cibse.org/bpa**

AWARDS JUDGES

Rowan Crowley, managing director, CIBSE Services

Justin Bere, director, Bere:architects

Richard Caple, president elect, Society of Light and Lighting

Munish Datta, head of facilities management and Plan A, Marks & Spencer

Hywel Davies, technical director, CIBSE

Bill Gething, professor of architecture, University of the west of England

Mark Hawker, senior engineering design manager, property, Sainsbury's

Susan Hone-Brookes, environmental leader, Laing O'Rourke

Sara Kassam, head of sustainable development, CIBSE

Mitch Layng, associate director, portfolio energy management, M&G Real Estate

Neil Lewis, managing director, Waterman Building Services

Michelle Perry, key account manager, Trox

Sarah Ratcliffe, programme director, Better Buildings Partnership

Simon Renford Gordon, development manager, Lendlease

David Stevens, vice-chair, CIBSE FM Group

Mark Sutton Vane, director and principal, Sutton Vane Associates

David White, managing director, Building Services Design

NICHOLAS HARE ARCHITECTS

CREATURE COMFORTS

How do you turn a brutalist, uninsulated, concrete structure – housing the University of Cambridge's zoology department – into a naturally ventilated showcase of sustainability that encourages collaboration between conservation groups? **Andy Pearson** finds out

'A drama of violence'. That was the description architectural historian Sir Nikolaus Pevsner gave of the University of Cambridge's Arup Building in 1971, while the building was still under construction. Now, more than 40 years later, Sir Philip Dowson's design is recognised as an important example of one of the 20th century's most controversial architectural movements. More recently, architectural historian Barnabas Calder described the building as 'Cambridge's most elating piece of brutalism'.

Dowson worked for Arup Associates – hence the building's name – and his design celebrates concrete as a construction material. The building has a reinforced-concrete frame, which rises up from a two-storey, brick-clad podium and a slender ground-floor space to support a massive superstructure of three reinforced-concrete floors, each extending out over the one below. Even the building's façades are concrete, albeit interspersed with ribbons of steel-framed single glazing.

While architectural historians might find the building's appearance joyous, the experience for occupants was anything but. The façade was poorly insulated and this – combined with the large areas of single glazing – produced a building that was too hot in summer and too cold in winter, and that leaked energy. In fact, its energy performance was one of the worst of any building on the university's estate.

In 2012, engineer Buro Happold was appointed – along with Nicholas Hare Architects – to develop a refurbishment solution for the 16,000m^2 building, which housed laboratories for the university's materials science, metallurgy and zoology departments on its upper floors. Its podium, meanwhile, was home to a 450-seat lecture theatre and the Museum of Zoology. The proposal was for the podium lecture theatre and museum to remain, but for the upper

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floors to become the new home for Cambridge Conservation Initiative (CCI), a collaboration between the university and a group of local biodiversity and conservation organisations.

The CCI was looking for a building actively to encourage collaboration between its members, to maximise its impact. From the outset, the new tenant made clear that it wanted its campus to be 'as green a building as was possible'. It pushed for the sustainability credentials to go well beyond the industry norm, to become an exemplar and help reinforce its message to visiting academics, conservation practitioners, policy-makers and business leaders.

Although the Arup Building is not listed, the task for the design team was to turn this uninsulated, single-glazed, brutalist icon into a showcase of sustainability best practice, while preserving the architectural integrity of the original design. To establish the project goals, stakeholder engagement workshops were held, involving the future tenants, the university's estates energy, environment and facilities management team, the architect and Buro Happold. Rather than aim for a specific Breeam rating for the refurbishment, Buro Happold pioneered what Andy Keelin – a partner at Buro Happold Engineering – terms 'a bespoke sustainability framework'. He says the solution was developed 'because of the lack of environmental assessment methods that deal with a building of this nature, with its multiple uses, the tenant's level of ambition and the increased emphasis on some aspects of sustainability'.

The framework set project-specific targets across 10 headline themes and 50 sub-themes. These included sustainability targets for the design team and for the building users, once they took up occupancy, to ensure the sustainable potential of the building was maximised. Headline targets included a 40% reduction in operational carbon emissions, a 30% reduction in water use per person, and 60% of the roof given over to a biodiverse green roof. The framework also included less-conventional aims, such as occupant wellbeing and ensuring the building educated visitors and facilitated collaboration. According to Keelin, the framework went down well with the planners because 'they could see how seriously we were taking sustainability'.

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Before starting to develop a sustainable engineering solution for the refurbishment, Buro Happold set out to gain an in-depth understanding of the thermal performance of the existing building. This included a thermal-imaging survey of its fabric, which showed the worst-performing aspects of the façade to be the single-glazed windows and their steel frames, and the concrete panels above and below the glazing.

The engineer carried out a full energy audit – using data from the past three years' energy bills – to benchmark the building and to show the pattern of energy use. Buro Happold also undertook a Building Use Studies occupant satisfaction survey, to garner information from the current occupants about comfort conditions within. Unsurprisingly, this revealed that the building was too hot in summer and too cold in winter.

The investigations also threw up some interesting facts. 'We found out that the boilers were undersized for the job that they had been asked to do, which meant gas consumption was unrealistic – but no-one had realised because the occupants had compensated for the lack of available heat by plugging in electric heaters,' says Keelin.

In addition to the energy surveys, the building was point-cloud surveyed to get accurate dimensional data for the interior. 'Because it is a refurbishment, you have to understand the constraints imposed by the building on the proposed design solutions,' Keelin says. The engineers also modelled the new atrium the architect wanted by extending an existing lightwell down to the lower floors to bring light into the heart of the building.

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'We modelled this to demonstrate the value it would add.'

When it came to developing a services strategy, Keelin says the approach was to work with the existing building: 'We set out to make the fabric work hard to reduce the cooling and heating loads, and to remove as many of the services from the building as we could.'

The original building had been designed with some naturally ventilated areas, but was predominantly heated and cooled by a ducted air system. 'Our approach was to strip out the ductwork, remove the suspended ceilings to expose the thermal mass of the concrete soffits, and pursue a natural ventilation strategy,' adds Keelin. This was helped by the relatively generous floor-to ceiling heights.

The key to successful, natural ventilation of the building was to upgrade its fabric to modern standards. At the time, Part L 2013 of the Building Regulations was still under consultation, and not yet enforced, so the designers set out to achieve a fabric performance at least 25% better than the existing Part L2B 2010, in order to meet the expected performance requirement of the 2013 regulations.

The scheme's design-stage performance demonstrated that the 'actual building' achieved an overall improvement of 30.8% compared with a 'notional building' compliant with the limiting elemental requirements of Part L2B 2010. This figure provided a buffer of approximately 5% above the aspirational target, allowing for any minor reductions in as-built performance that might arise through final product selections and their installation.

To preserve the building's integrity, modifications to the fabric were varied depending on the architectural sensitivity of an area of façade. Certain walls on the lower ground and podium, for example, could not be upgraded. As a result, the fabric performance in other areas was upgraded beyond the level required by Part L2B 2010. Using the emissions approach to compliance ensured that the disparity in CO_2 emissions from not uniformly upgrading the building fabric could be accounted for through enhanced carbon-saving improvements elsewhere. The final EPC has still to be produced.

One of the most obvious energy efficiency wins was to replace all of the windows with double-glazed units. The replacements match the fenestration patterns and mullion profiles of the originals, and incorporate actuator-driven opening top lights, to facilitate night ventilation and manually openable low-level units. 'Because we were recladding the building, we were able to have top and bottom opening windows to increase ventilation efficiency,' says Keelin. To upgrade the thermal performance of the external concrete walls, an insulated internal lining was added.

The one area where there was little exposed concrete was the building's top floor, because the original roof was a lightweight construction based on a thin wood-wool slab set on concrete beams. In the refurbishment, this has been replaced by a structural metal deck supporting a warm roof construction above. To add thermal mass, the metal soffit has been lined with phase-change material (PCM) panels,

The roof

More than 60% of the roof area is vegetated, with planting chosen to replicate that of the local chalkland to encourage wildlife. On the roof are bee hotels, and bat and bird boxes, with live CCTV connections back to displays in the Cambridge Conservation Initiative atrium. The planting improves the thermal insulation and helps to attenuate rainwater run-off as part of the building's sustainable drainage strategy. The roof also includes 86.22m² of photovoltaic panels – and 73.5m² of PV glazing at the top of the new atrium – potentially generating a maximum of 16.5kW of electricity.

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installed between the concrete secondary beams. The addition of the PCM ensures the soffit behaves in a similar manner to the soffits on the lower floors.

The building's natural ventilation design was based on the CIBSE standard approach; for example, the internal temperature exceeds 28°C for less than 1% of the occupied period. 'Our initial aim was to ventilate the entire building naturally,' says Keelin. 'Ultimately, we didn't achieve that goal; instead, we got to a point where 70% of the building is naturally ventilated, with the remainder mechanically ventilated.'

To maximise the impact of the natural ventilation, open-plan offices have been strategically placed around the building's perimeter to benefit from opening windows. The spaces that require mechanical ventilation – such as meeting rooms and IT cupboards – have been clustered in the middle of the floor plates. 'All the spaces that need mechanical ventilation can have it, while everybody else will benefit from natural ventilation at the building's perimeter,' says Keelin.

Internal spaces are ventilated using a variable air volume (VAV) system designed with low specific fan power and incorporating heat recovery. A total of $9m^3 \cdot s^{-1}$ of fresh air is provided by five roof-mounted air handling units (AHUs) – and two additional AHUs, one on the lower ground floor and one in the basement – based on $10L \cdot s^{-1}$ per person at a temperature of 24°C +/-2K. The archive stores on the lower ground floor are also mechanically ventilated, with air supplied at 18°C +/-2K – and relative humidity at 55% +/-10% – year round.

To support the ventilation solution, Buro Happold assessed the likelihood of the building overheating in the future, based on probabilistic climate data for Cambridge for 2030 and 2050, using a high-emissions scenario. This showed that it could become uncomfortable, so a number of precautionary design measures were adopted, including future-proofing the window actuator controls to enable mixed-mode ventilation to be accommodated at a later date.

The first CCI members moved into the building in December 2015 and, by early 2016, the remainder were established in the new space. The building is extensively metered and the results displayed in the atrium to encourage responsible energy use and demonstrate the building's exemplar performance. Because of the discovery of asbestos, the museum – the final part of the building – is due to open slightly later than planned, in February 2017.

The project includes soft landings to ensure sustainable occupation. Keelin says it is still too early for any meaningful monitoring results, but reusing the building is claimed to have saved 82% of embodied carbon.

Another significant detail is that, since its £57.8m refurbishment – and in light of its new sustainable credentials – the building has been given a new name: the David Attenborough Building. **CJ**

> The boilers were undersized, so gas consumption was unrealistic – but no-one had realised because the occupants compensated by plugging in electric heaters

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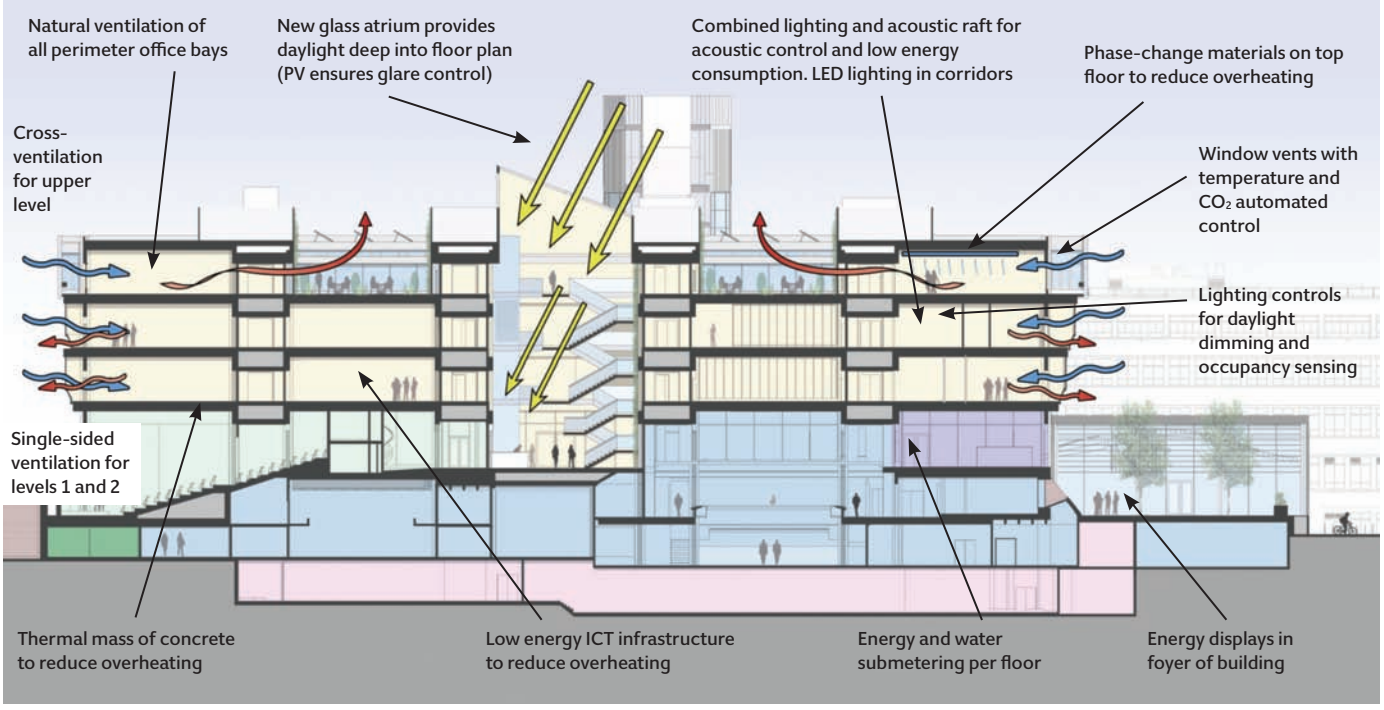

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Section view showing sustainability initiatives

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IF EVERY DAY WAS LIKE CHRISTMAS

Churches may be full to bursting at Christmas, but smaller congregations at other times make planning a heating strategy difficult. In response, **James Sheehan**, heating adviser for the Diocese of Peterborough, has produced a cost guide that aims to minimise ecclesiastical heating bills

Patterns of church use can vary sharply from parish to parish. A flourishing church in a growing community may have a daily service, while a remote chapel with an ageing congregation may only have a service on Sundays.

People still need to be warm and comfortable, though – no matter how full the pews. As churches tend to be uninsulated, this means dioceses have to spend thousands every year to keep their parishioners warm; they also have to keep the heating on between services, to minimise the risk of surface and interstitial condensation on the building fabric.

To calculate the most efficient heating levels in a church, it is important to consider the minimum temperature to which a church can be heated without risking condensation, and what heating levels are required to stop a congregation focusing on keeping warm.

The study that informed the guidance considers the energy use of heating a typical church in winter, and at the costs of various heating strategies. It encompasses churches with between one and seven services a week, and assumes controlling minimum temperatures between 8°C and 12°C.

Changing minimum internal temperatures can have a dramatic effect on heating costs. By reducing the temperature from 12°C to 8°C, for example, a typical church could save more than £4,500 during the heating season (See Table 1, Energy and heating cost guide). A reduction to 8°C should be considered if the church is unused between services.

This underlying study was based on the winter climate in the East Midlands, but may be applied to other UK areas with a different climate. Other assumptions can be seen in the panel 'Study assumptions'.

The construction of churches is extremely varied, with alterations and extensions sometimes carried out centuries after the building was first put up.

Materials may also be non-uniform, and traditional churches have little or no fabric thermal insulation.

There are many factors that contribute to heating requirements in a church, including: building fabric type; window areas and type; the provision of doors and porches; prevailing wind directions; and ventilation infiltration rates, including the impact of cold draughts.

The thermal mass of the construction will have to be taken into account, as will: transmittance and admittance; specific heat; space temperature gradient; distribution losses from thermally insulated main services; heating plant response; and maintained efficiency.

Allowances should also be made for cold air infiltration and adventitious solar, occupancy, power and lighting gains. (For more on calculating thermal performance of historic buildings see 'Cambridge First', *CIBSE Journal*, June 2016.)

Heating plant and system outputs should be determined as accurately as possible, in accordance with agreed project design parameters. Heat outputs may vary, typically in the range 100kW to 300kW.

Church heating systems are typically designed to raise the temperature during preheating to 20°C immediately before occupancy, and maintain that temperature for approximately one hour, depending on the type of service or event. Boiler and system heat output must be sufficient to ensure satisfactory economic preheating of the church. Churches and associated facilities are often used on a highly intermittent basis.

To protect the building fabric from surface and interstitial condensation, minimum limit temperature can be maintained in the 8°C to 12°C range. Higher internal surfaces should be considered to protect the building fabric against condensation in very well-attended churches.

The study

The study is based on a church of 728m^2 treated floor area and 7,220m^3 heated space volume. Design preheating and seasonal heating loads were calculated using an IES model programme, CIBSE loads and dynamic simulation. Boiler output was determined from space design preheating load plus 2.5% mains loss and 7.5% margin.

The study is based upon the use of a conventional new, high-efficiency, natural-gas-fired, condensing low-pressure hot water (LPHW) modular heating boiler and system, rated at 200kW nominal total heat output using fan convector heat emitters. Associated electrical energy use is relatively small and has been omitted.

The heating energy cost guide is subject to variation in energy usage during prolonged mild or severe winter weather, above or below the average monthly temperatures. Actual heating energy use can be expected to vary, on average, by up to ± 10% of guide figures when using a 200kW boiler.

Calculated figures have been extracted from a current church project in the East

> Construction of churches is extremely varied. Materials may be non-uniform, and traditional ones have little or no fabric thermal insulation

STUDY ASSUMPTIONS

Winter space-heating loads may be established using local winter weather conditions prevailing at -3°C typical external ambient design air temperature, in accordance with CIBSE Guide recommendations for heavyweight buildings with overload capacity, using computer model and dynamic simulation.

Seasonal variation in space-heating loads may be based on CIBSE climate frequency data or programmed data throughout a typical winter of 30 weeks' (seven months') duration. Heating has been assumed to be required from October to April, with simultaneous operation of all control zones.

Dynamic simulation will normally include one to two weeks of design weather for space-heating and system frost protection when external ambient dry-bulb temperatures may be at or below design.

MATT CARDY / STRINGER / GETTYIMAGES

> People need to be warm and comfortable – no matter how full the pews

Table 1: Energy and heating cost guide

Control	kWh/week Energy	Cost/week £	Cost/month £	Cost/heating season – £
Continuous operation				
8°C minimum internal temperature	1,758	70	301	2,110
10°C minimum internal temperature	2,946	118	505	3,535
12°C minimum internal temperature	4,144	166	710	4,973
15°C minimum internal temperature	6,003	240	1,029	7,204
Intermittent operation				
Preheating to 20°C internal air dry-bulb temperature for one hour; preheating to 20°C internal air dry-bulb temperature for one hour; occupied period; 8°C minimum limit maintained at all other times:				
One service/week	2,246	90	385	2,695
Two/week	2,734	109	469	3,281
Four/week	3,709	148	636	4,451
Seven/week	4,689	188	804	5,627
Preheating to 20°C occupied and 10°C minimum limit:				
One service/week	3,297	132	559	3,910
Two/week	3,647	146	625	4,376
Four/week	4,349	174	746	5,219
Seven/week	5,401	216	926	6,481
Preheating to 20°C occupied and 12°C minimum limit:				
One service/week	4,395	176	753	5,274
Two/week	4,645	186	796	5,574
Four/week	5,145	206	882	6,174
Seven/week	5,895	236	1,011	7,074
Preheating to 20°C occupied and 15°C minimum limit:				
One service/week	6,140	246	1,053	7,368
Two/week	6,276	251	1,076	7,531
Four/week	6,548	262	1,123	7,858
Seven/week	6,957	278	1,194	8,355

The heating energy cost guide includes the cost for continuous and intermittent heating operation. Costs are based on typical 4p/kWh current overall natural gas tariff charge, which can be adjusted for other tariffs, and have been rounded up or down to the nearest pound to assist comparison.

The importance of controls

Choice of control method has a significant impact on the gas utility bill.

Building energy management systems' (BEMS') heating control normally includes: optimum start; external temperature compensation; variable heating flow rate; and burner modulation turndown, to promote condensing operation and thermal efficiencies throughout the range of seasonal heating loads, with facility for zone and external remote control. Basic time-clock and thermostatic control may suit smaller projects.

Zone control is useful when a building layout may be suitable for division into separate areas, to maintain efficient operation of heating in all zones.

Midlands. Figures will vary on other projects with similar overall heat output but different constructions. Interpolation or extrapolation of tabulated figures can be applied with caution to other projects with larger or smaller heat outputs and similar general design parameters and control.

Continuous heating operation is shown in the table for comparative purposes only, and cannot be recommended unless the available fuel budget of the church determines otherwise. While maintaining an 8°C continuous minimum limit temperature will provide building-fabric protection against surface or interstitial condensation, it is well below a recommended air dry-bulb temperature of 20°C in churches.

Summary

Intermittent heating operation with minimum limit control is recommended to provide satisfactory comfort during occupation with optimum use of energy.

The cost of intermittently heating the above church once a week for a service, function or event of one-hour duration at 20°C occupied air dry-bulb temperature – while maintaining minimum limit temperature of 8°C at all other times – is £2,695 from the table over the course of a heating season.

For two, four and seven services a week, the costs are £3,281, £4,451 and £5,627 respectively. The range of these costs is from £2,695 to £5,627 – a difference of £2,932 or 109% of minimum cost.

If intermittent heating to 20°C air dry-bulb temperature and 15°C minimum limit was maintained, costs would range from £7,368 to £8,355 – a difference of £987 or 13% of minimum cost.

Where the number of daily visitors to the church between services or events is significant, a 12°C minimum limit temperature would be desirable during the winter, but the energy and fuel use is appreciably higher than maintaining 8°C minimum temperature. To reduce energy, maintain the 12°C minimum temperature during the day for visitors, but allow the temperature to decay to 8°C control minimum overnight and when the church has no – or very few – visitors.

Choosing a lower air dry-bulb temperature of 18°C reduces energy and fuel use, as does operating fewer heating zones, or operating heating for less than 30 weeks a year if the prevailing winter weather permits. **CJ**

JAMES SHEEHAN is a director of James Sheehan Consulting Engineers

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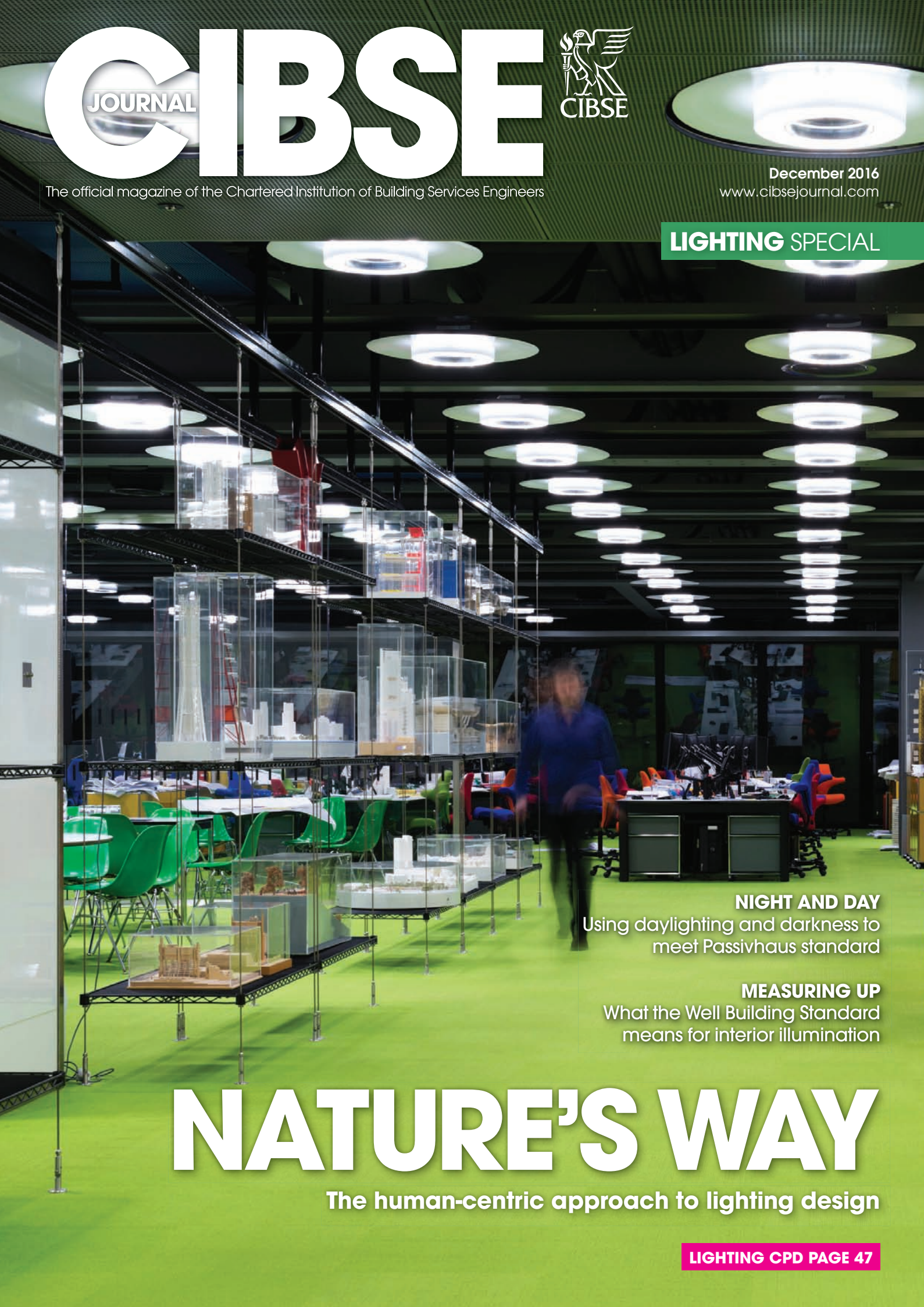


NIGHT AND DAY
Using daylighting and darkness to meet Passivhaus standard

MEASURING UP
What the Well Building Standard means for interior illumination

NATURE'S WAY

The human-centric approach to lighting design

LIGHTING CPD PAGE 47

BODY CLOCK WISE

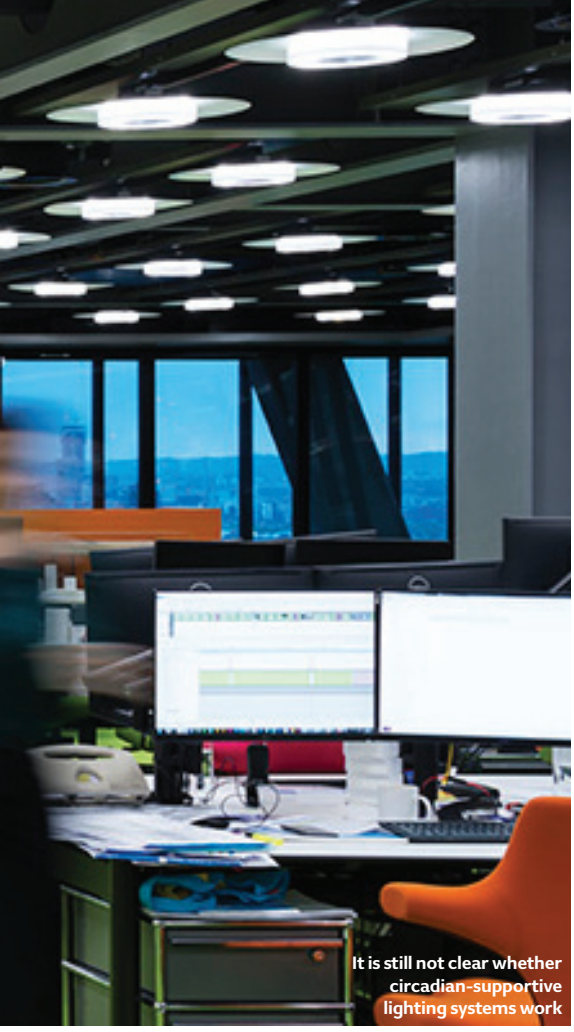
Human-centric lighting is a phrase that has been bandied about over the past couple of years – not least by lighting manufacturers – but what does it actually mean? **Jonathan Rush** explains

Human-centric, biodynamic, chronobiologic, biophilic, circadian, melanopic... whichever term you use, they herald a new era for lighting designers, based on the non-image-forming functions of the human eye. Understanding of these functions largely dates back to the 1990s and the discovery of intrinsically photosensitive retinal ganglion cells (ipRGCs) in the retina. If these cells do not receive light for two hours, melatonin is produced, which triggers the sleep or circadian cycle. (See panel, 'The eyes have it').

Essentially, it means your eyes and brain receive signals from the external day/night cycle, which tell your body when to be awake and when to sleep. Many of us now spend 90% of our time indoors, in artificial light, often staring at screens for more than seven hours. So the feeling is that our connection with the outside has been lost and, with it, the spectrum of daylight that maintains a normal sleep cycle.

It's a seductive argument; we spend more time in artificial lighting environments, and more time exposing ourselves to blue-spectrum light, when we should be relaxing in the warm glow of a candle. It is understandable that this may be impacting on our sleep patterns, and evidence does suggest that messing with the sleep cycle is bad for you, as reflected in higher rates of cancer, diabetes, ulcers and heart disease among shift or night workers.

How do we design lighting to support a circadian system? With LED light sources came the ability to dim and colour mix; these developments have run parallel with research into circadian rhythms – and so circadian lighting was born. This is a set-up – usually for offices, but sometimes for education or care environments – which carries out colour temperature and illumination change throughout the day. A sort of artificial sunrise to sunset, which travels from 2,700K to 6,500K and back again.



It is still not clear whether circadian-supportive lighting systems work

The idea is that by providing appropriate-intensity, blue-spectrum light during the main daylight hours – and warmer spectrum when the body should be relaxing – you create an environment for melatonin suppression for alertness and cortisol release, which controls body temperature. So does it work?

A number of case studies in schools, hospitals and offices suggest that it does. Students, for example, have been said to concentrate better after the installation of a circadian-supportive lighting system, because of the colour-change element. However, in many cases, the schools previously had poor lighting and dark, dirty interiors, so the improvement could be a result of the fresh, new, well-lit interiors – after all, we know that good lighting can engage and invigorate, and doesn't have to mix colours to do that.

Many studies rely on subjective answers from people asked directly about their response to new lighting once the system and 'benefits' have been explained. As a result, this evidence could be unreliable.

So although research is available, it is not entirely convincing. One of the reasons is that we don't know what we are supposed to be testing. How do we quantify the effects and 'doses' of circadian lighting?

Scientists from the University of Manchester have proposed the melanopic illuminance curve of eye sensitivity. Like the Vλ curve of photopic eye sensitivity, the melanopic curve looks at wavelengths of light for melanopsin in the ipRGCs[1].

This curve represents the best model for understanding the appropriate spectral wavelength for melanopsin and can be used to build the light spectrum appropriate for an internal luminaire. It is the closest we have to quantifying the spectrum required for melatonin suppression, but as the scientists state: 'It is not always clear whether lighting design should aim to maximise or minimise non-visual responses. In many ways, light can be considered a drug, having the potential for both beneficial and deleterious effects. These conflicting effects can occur concurrently, and in a single individual and context.' And again: 'It is not yet possible to predict the non-image-forming impact of a given illuminant based on its intensity and spectral composition. However, some guidance is

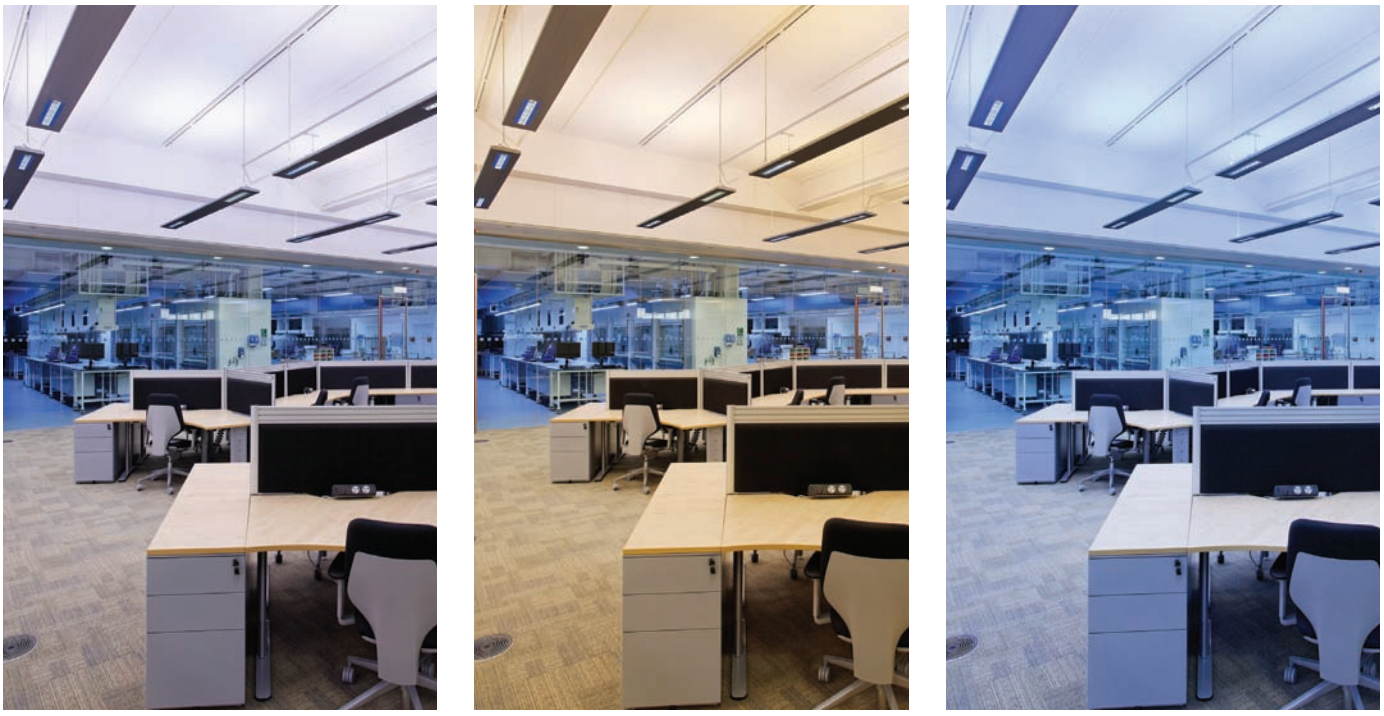
> As a designer, I am concerned that these lighting systems are being installed now, when research is in its infancy

The eyes have it

Intrinsically photosensitive retinal ganglion cells (ipRGCs) in the retina receive light and use it to send messages about the external light/dark cycle to the rest of the body. If ipRGCs do not receive light for two hours, they send a message to the hypothalamus, which contains the suprachiasmatic nucleus (SCN), and this – via the pineal gland – starts the secretion of melatonin, so triggering the sleep, or circadian, cycle. The SCN acts as the master circadian clock, overseeing a near-perfect 12-hour-cycle timeclock in each of the body's 37.2 trillion cells.

The photo pigment in ipRGCs is called melanopsin, and this – together with rods, and blue, red and green cones – make up our non-image-forming system within the retina. Each element is more sensitive to different wavelengths of light and values of irradiance or amount of light.

In circadian lighting terms, the 'superstar' wavelength is in the blue spectrum – about 480nm, the peak sensitivity of ipRGCs. The impact of blue-spectrum lighting is not new; in the late-1990s, research by lighting manufacturers suggested that a punch of blue-spectrum light would stimulate workers, rather like battery hens. It is also the dominant spectrum in daylight – and perhaps this is the key to understanding the subject.



Dynamic lighting can be useful in spaces where there is a lack of daylight, to give people a connection with conditions outside. In 2010, Hoare Lea Lighting's design for AstraZeneca used fluorescent lamps, with high-frequency control gear – so no flicker – to create different colour temperatures

possible.'[2] Even the international commission on illumination, the CIE, recently released a statement regarding clarity on the latest thinking (See panel, 'Missing links').

Others are more supportive of the system. Mark Rea and his team from the Lighting Research Center, in New York, believe in the validity of circadian lighting. The Well Building Standard offers melanopic illuminance values measured vertically at face height as a key to creating healthy lighting, and the German standard – DIN Spec 6760 – offers metrics for 'biologically effective' lighting.

Are there risks? One issue is the one-size-fits-all approach. People are different – from our chronotype (how we sleep), to our geography, work pattern, diet, age and subjective responses to light. We know, for instance, that the eye yellows and receives less blue-spectrum light as we age, and that a person of 50-60 years secretes about 35% of the melatonin of a 10-year old.

And what about preference? Research suggests blue-spectrum light is needed, but does anyone want to work in 6,000K-8,000K artificial light? Our geography will also influence preferences; for example, the definition of cool white light in the Middle East is different from that in western European – so, if science tells us it has to be 8,000K, will we accept this? Will we bury our preference for the sake of sleep? What if we require 5,000 lux? Will our energy targets cope with additional loads?

We also have to consider whether additional blue light is OK for our eyes. Short-wavelength blue light hits the retina faster than long-wavelength light, and could cause oxidative stress in the retinal tissue. Public Health England has stated that normal LEDs are not an issue in this sense, but what if we raise blue spectrum levels? Age-related macular degeneration, the leading cause of vision loss in the UK, affects 600,000 people – and is on the rise. Could an increase in blue light spectrum be causing this?

There is also flicker. With mixing between colour sources comes dimming, and dimming often causes flicker. Many electronic drivers for LEDs have high flicker modulation, similar to that of old fluorescent lighting that a generation said gave them headaches. Could a dimming or colour-mixing system cause detrimental flicker?

So there are many unknowns and we need to be cautious. As a designer, I am concerned that these lighting systems are being installed now, when research is in its

MISSING LINKS

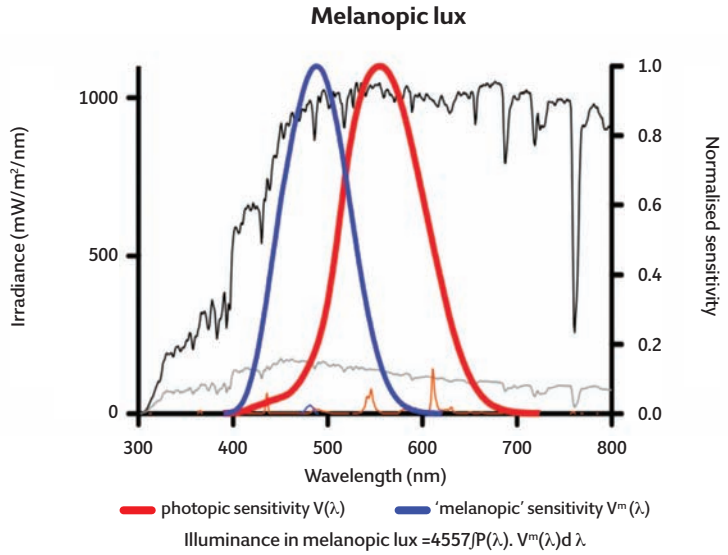
'Non-visual responses are subject to complex signal processing in the central nervous system and influenced by as-yet-unresolved interactions of photoreceptive units. The missing understanding of the input-output characteristics between light stimulus and the resulting non-visual response seems to make tailored light application for a desired lighting effect impossible.'

CIE statement on non-visual effects of light – *Recommending Proper Light at the Proper Time*

infancy. We should not forget that we already have a wonderful, rich, bright, wireless and free source of light that gives us all we need in terms of spectrum, infrared, UVA, UVB, illuminance, social interaction and psychological wellbeing: it's called daylight. We can build intelligent lighting systems in our workplaces, schools, public buildings, care facilities – even our homes – but the fact remains that if you make sensible decisions about exposure to daylight, you will have a healthy circadian rhythm.

So my advice is educate people about the need for daylight; make people move, get fresh air and understand the importance of 'visual wind down' in the evening, with warm spectrum, dimmed lighting easing sleep. Reduce the electronic devices used in your home in the evening and use blackout curtains to sleep in a dark environment.

We should also educate developers about daylight, and design spaces that people wish to use and illuminate them appropriately. Avoid the gimmickry of dynamic colour-mixing. Instead, consider designing a space that is 'melanopic neutral' – that does not have a detrimental impact on the circadian system – by avoiding warm spectrum light and dim illumination levels. Finally, wait for the scientists to test the impact of circadian light in care and dementia homes, and on shift workers – those with a real need. And, if the results are positive, then look at how to apply this knowledge to offices, homes and public spaces.



Courtesy of Robert Lucas, University of Manchester after al Enezi et al (2010)

References:

1 Al Enezi J, Revell V, Brown T, Wynne J, Schlangen L, and Lucas R (2011), *Journal of Biological Rhythms*, 26(4), 314-323.

2 Lucas et al, *Measuring and Using Light in the Melanopsin Age*, 2014

JONATHAN RUSH MSLL is a partner, lighting design, at Hoare Lea

The Enterprise Centre at the University of East Anglia has just won the 2016 Lux Award for office, education and healthcare lighting project of the year. **Colin Ball** outlines the radical approach that began with darkness

ENLIGHTENED THINKING

The Enterprise Centre is a unique and innovative project. To succeed in creating one of the largest non-domestic Passivhaus projects in the UK, the supply chain had to change the way it worked. It demanded new contacts, new methods and new materials. In a single project, the rulebook was rewritten – and that included for the lighting.

Achieving Passivhaus and Breeam Outstanding, the Enterprise Centre has been described as the greenest commercial building in the UK, recently winning *The Guardian* Design Award for Sustainability. Designed to last for 100 years, it has been built on a brownfield site using 70% bio-based materials, most of which were locally sourced.

Consequently, over its lifetime the building's embodied carbon is predicted to be one quarter that of a conventional structure. This two-storey, 3400m^2 building is the new home for the Adapt Low Carbon Group, created to commercialise graduate start-ups that have grown out of UEA's world-class school of environmental sciences, and which was instrumental in developing the vision for the building.

Where possible, materials have been sourced, tested and fabricated within 30 miles of the site, with the balance procured from elsewhere in the UK. Examples include the timber-frame construction, for which 70% of the studwork was sourced from Thetford Forest, as were the striking larch glue laminated timber columns supporting the entrance canopy.

Lighting in a conventional scheme would take up one-third of the building's energy consumption. In a Passivhaus project, where heating is minimised, a conventional lighting scheme would be responsible for more than half of consumption and would not be plausible.

The use of LED lighting, the new industry standard, would afford us a 20% energy saving but we generally needed to look at lighting in a different way. If we lit the people for their task and action, rather than just illuminating the space universally, we could look at supplying adequate lighting when and where it was needed.

This is not a simple task when there is a need also to meet occupant health and comfort requirements – one cannot light a single desk in a large space and assume the occupants will be comfortable in a pool of light surrounded by inky blackness.

For many years, we have studied the changing cycle of light from day to night and are well aware that a person's comfort in the morning requires a different lighting condition from that of the late afternoon and evening, through to night-time. Recent studies have demonstrated the direct effect on melatonin within the brain and its rhythmic cycle of being stimulated or suppressed by sky-blue light.

The result of this is that we now have demonstrable results in increased productivity in workplaces, boosted concentration and better exam results in schools, where diurnal cycles of light have been implemented. Contact with natural

PROJECT CREDITS

- **Architect:** Architype
- **Structural and building services engineer:** BDP
- **Lighting design:** BDP
- **Contractor:** Morgan Sindall

The Enterprise Centre lighting at night

> It enabled us to eliminate all lighting for a third of the floor plan, as well as associated cabling and services within the ceiling

light and its penetration into a building is as essential for the sense of wellbeing of the occupant as the ability to reduce power use.

The design for the Enterprise Centre maximises the use of daylight wherever possible. This, therefore, provided the bright early morning light of the diurnal cycle. But what about the rest of the day?

From our first introduction to the client, we promoted the concept of the diurnal cycle, and explained that darkness and pools of light at night are an essential part of the same cycle. We demonstrated that lighting had worked perfectly well for decades before the invention of fluorescent lamps, and that productive lighting, solely illuminating task areas, had been valued in office schemes. We showed how luxury environments were nearly always warmly lit at low levels with high contrast areas of interest and, as a result, we recommended to them a 'business class' environment for the evening setting of their building.

The client accepted our proposal and we were able to establish warmth and intimacy in working spaces, with controllable lamps for occupants. This allowed us to eliminate lighting for a third of the floor plan, as well as associated cabling and services within the ceiling. We provided localised accent lighting, through furniture only, to all workspaces. The only ceiling lighting system we needed to retain, was for high-circulation spaces, for the benefit of emergency lighting and general ambience on dark winter days, and for flexible teaching spaces, where additional furniture items were problematic for the building's end-users.

The principle aim was to light people and their actions, not to light the space. Where the architecture requires illumination we tuned the daylight and the architecture itself to get this right.

All ceiling lights have been positioned in shadows where daylight does not penetrate and have been programmed to switch on only when natural light is insufficient. This has not only reduced the usable energy of the lighting system by 80%, but reduced the embodied carbon of electrical infrastructure by a further 40%.

We surveyed the occupants for a year, assuming we would need to calibrate control settings, but we have found that we did not have to change anything. The most resounding comment we have had from occupants is: 'Yes, it's dark – we love it.'

COLIN BALL is a director at BDP Lighting

Daylight texture and contrast

Night texture contrast

Cundall Light4 took a localised lighting approach to its recent scheme for QBE Insurance's London head office

A HEALTHY

The Well Building Standard considers the biological impact of light – and this 'melanopic' approach will have implications for lighting workplaces, says **Andrew Bissell**

Developed in the US and gaining traction in the UK, the Well Building Standard might change how we light our buildings.

The standard is an evidence-based system for measuring, certifying and monitoring the performance of building features that impact on occupants' health and wellbeing. It identifies seven concepts – air, water, nourishment, light, fitness, comfort and mind – which all focus on people.

Each concept includes features, some of which are preconditions (mandatory) and some optimisations (optional). Currently, only one UK office is set to achieve the Gold Well Building Standard (see 'A picture of health', *CIBSE Journal*, September 2016).

Items 53 to 63 of the standard relate to lighting. This thorough list of 11 features gives a sense of depth to the lighting concept, with the most notable being circadian lighting design. This has been the subject of much research and discussion but, to date, a numerical target has not been set.

It is worth noting that rights to light, daylight modelling and daylight fenestration are optimisations, not preconditions. In the UK – especially now that climate-based daylight modelling is more widely accepted and used – failing to mandate daylight standards appears to be a missed opportunity.

However, the daylight modelling feature (62) adopts the spatial daylight autonomy (sDA) and annual sunlight exposure (ASE) methods of analysis. This at least means that, if selected as an option, the building form, orientation, façade, fenestration and interior design will be modelled using local real-sky data and absolute lux values.

> Recessed grid lighting solutions – seen as the panacea for flexibility for clients – fail to light the horizontal surfaces well once furniture is included

Visual lighting design

The essence of this feature (53) is that a background illuminance of 215 lux is provided on a horizontal plane 0.76m above finished floor level. Task lights are then added to the space where the lighting level needs to be 300 or 500 lux.

LIGHT STYLE

The use of the word 'task' in this item is both interesting and misleading. It is interesting because there is an ambition to put light where it is needed and not 'blanket light' a space. However, it is misleading because task lighting is generally taken to mean a desk-mounted light, when the more common – and, typically, client-preferred approach – is to use suspended fittings.

As the phrase 'localised lighting' has become more commonly used in the UK, so have discussions about what it means precisely. The health and safety guidance HSG38 says: 'Localised lighting provides different levels of illumination in different parts of the same working area.

It matches the level of illumination to the needs of specific tasks.' This seems appropriate while – at the same time – not tying the lighting designer to a particular type of fitting. Perhaps in the next Well Building Standard revision, localised lighting will replace task lighting.

The final aspect of the visual lighting design feature is brightness and contrast management. The fact that the subject is discussed means people following the standard will be reminded to consider it.

Another positive is that the standard does not set numerical brightness targets or contrast ratios that cannot be exceeded. Instead, the designer is required to write a narrative on the subject, so needs to know what they are doing.

But could the lack of numerical direction leave this feature open to abuse? And to what extent are the people checking the narrative knowledgeable in lighting design?

The checkerboard grid layout delivered wildly different vertical lux levels between adjacent workstations, with measurements of 651 lux and 127 lux

Circadian lighting design

Circadian lighting is one of the most discussed topics in the lighting industry at the moment. While sufficient research has been done to indicate that light has an impact on our body clock, research into how much light is needed, the wavelengths, the timing during the day and the duration of the light is far from conclusive.

Despite this, the circadian lighting design feature (54) of the Well standard has set a target of 250 equivalent melanopic lux (EML), measured vertically at 1.2m above finished floor level. The 250 lux must be present in 75% of workstations for four hours a day, every day of the year, and can be a combination of daylight and electric light.

The first question has to be whether 250 EML is correct; there is insufficient research to say it is. However, in the absence of any other metric, we need at least to look at what delivering 250 EML to a workstation means. To calculate the EML, the Well standard offers a table of lamp correlated colour temperature (CCT) factors.

Using this method, a neutral white, 4,000K lamp has a factor of 0.58, so a measurement

of 100 lux would mean 58 EML. A much cooler 6,500K lamp has a factor of 1.02, whereas a warmer 3,000K lamp has a factor of 0.45. So it can be deduced that a 6,500K lamp would deliver the 250 EML far more efficiently than a 4,000K lamp.

To investigate how to achieve 250 EML in a typical open-plan office – in this case, a spec office in London – two designs were created: a typical checkerboard grid of linear recessed lights and one that followed the principle of localised lighting using suspended direct/indirect lights mounted over each desk.

In the checkerboard grid, the layout delivered, on average, 414 lux across the working plane in an empty office. However, when the furniture was added, the horizontal lux at each workstation varied from 568 lux to 290 lux. The difference was more dramatic between adjacent workstations when the vertical lux levels were calculated, with measurements of 651 lux and 127 lux.

If a 4,000K lamp is used, the workstations receive 378 EML and 74 EML respectively. Essentially, people sitting next to each other in an open-plan office with a so-called uniform lighting scheme are, in fact, receiving very different levels of EML. One meets the Well target; one fails to comply.

Using the same desks and calculation grids for the localised lighting solution, the horizontal results between adjacent desks varied from 557 lux to 525 lux. Vertically, the results between desks ranged from 707 lux to 581 lux. By adjusting the vertical lux levels to EML, the adjacent workstations receive 410 EML and 336 EML.

Clearly, further research is needed to establish whether the 250 EML target and many other factors are right. For example, should the four hours of EML only occur between, say, noon and 4pm, or should the EML be delivered by daylight only?

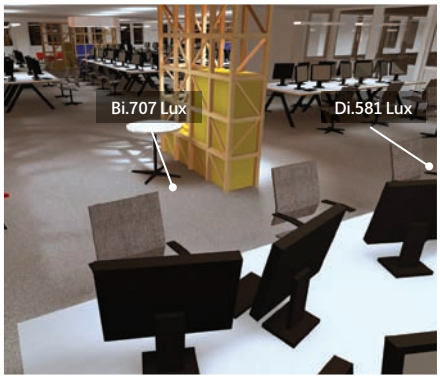
Many questions remain unanswered, but it is interesting to learn that recessed grid-lighting solutions – seen as the panacea for flexibility for clients – fail to light the horizontal surfaces well once furniture is included, nor can they deliver the vertical EML consistently to adjacent workstations.

By comparison, the localised lighting approach delivers the horizontal lux and vertical EML uniformly between adjacent workstations, and conveys far more EML than required by the Well standard.

Should solid evidence be found of the health and wellbeing benefit of 250 EML, could a worker sue their employer for poor sleep patterns? In such a case, it is likely the client would then claim from the designer or lighting manufacturer who sold the design and luminaires.

Maybe we are not quite there yet, but moving towards a lighting design that delivers more consistent horizontal and vertical lighting at workstations is good practice and removes the risk of future claims. Localised lighting also typically uses 65% less energy than a grid of lights – which, in itself, is a good reason to design the lighting specifically for the end user.

ANDREW BISSELL MCIBSE MSLL is lighting director of Cundall Light4



Using the same desks and calculation grids for the localised lighting solution, the vertical results varied between 707 lux and 581 lux. Adjusting the vertical lux levels to EML, the adjacent workstations receive 410 EML and 336 EML (equivalent melanopic lux)

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Providing acoustic and luminous performance in rooms without compromising access to building thermal mass

This module considers the challenges of meeting coincident demands for a good quality thermal, aural and visual performance – and the potential solutions

Successfully achieving excellence in the internal environment depends on understanding the wider impact that design decisions have on the whole building. One area in which this is particularly important is when trying to deliver good room acoustics without adversely affecting the thermal or luminous environment – and, at the same time, ensuring building aesthetics and usability are maintained or, potentially, improved. It would be unrealistic to be an expert in all of these areas, but this CPD considers some of the underlying challenges in meeting the coincident demands for a good-quality thermal, aural and visual performance – and the potential solutions available.

Thermal considerations

'Thermal mass' is the term typically used to indicate the ability of a building element to store heat. All materials have thermal mass. Some – such as bricks, heavyweight plaster and concrete – have higher thermal mass, while others – such as air and typical insulating materials – are lower in thermal mass.

The useful thermal mass is directly related to the value of the material's specific heat capacity ($J \cdot kg^{-1} \cdot K^{-1}$), conductivity ($W \cdot m^{-1} \cdot K^{-1}$) and density ($kg \cdot m^{-3}$), as indicated in Table 1.

Thermal mass acts like a thermal capacitor and, just like an electrical capacitor, the thermal mass will only charge or discharge – and so alter the amount of heat stored in the mass – when there is a variation in input on either side. Practically, this means that thermal mass would not be of great help where conditions are constant on each side of the thermal mass; for an extreme example, as in a continuously operating telephone call-centre building, or data centre, located in an equatorial or polar region. And – again, just like a capacitor – the rate at which thermal mass will charge or discharge will be affected by the resistances either side of it.

High (thermal) resistance layers – such as lightweight plaster, glass fibre, mineral wool, polystyrene, polyurethane, fibreboard, cellulose, timber, floor coverings and air – will thermally isolate the thermal mass from thermal influences. So, for example, a solid terracotta floor can have its accessible thermal mass – and so its effective thermal mass – significantly diminished if there is carpet and underlay added. This will lessen the thermal 'weight' of the room, considering the structure as if looking from the inside. This means that the room is likely to heat up – or cool down – rather more quickly than its heavyweight equivalent.

Thermally lighter structures could be useful; for example, if the room was used infrequently, and it was beneficial to heat the

Material	Material density ($kg \cdot m^{-3}$)	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)	Specific heat capacity ($J \cdot kg^{-1} \cdot K^{-1}$)	Potential thermal mass
Brick	1,750	0.77	1,000	High
Cast concrete	2,000	1.33	1,000	High
Plaster (dense)	1,300	0.57	1,000	High
Polyurethane foam	30	0.025	1,400	Very low
Timber	500	0.13	1,600	Low
Carpet/underlay	200	0.6	1,300	Very low

Table 1: Example thermal properties for common building materials (Source: CIBSE Guide A4)

room up (or cool it down) swiftly. However, this may not be so useful if the thermal mass could be beneficial for offsetting the instantaneous room heat losses or gains by acting as a thermal 'flywheel' – providing stability to the room temperatures.
The effective thermal mass of a building structure made of several layers of material can be altered by shifting the position of the insulation relative to the layers of high thermal mass.

The thermal transmittance (U value, $W \cdot m^{-2} \cdot K^{-1}$) will not be affected by the position of the insulating layers, so the steady state (and average) heat flow through the structure will be independent of the insulation position.

Not having insulating layers on the inside makes the thermal mass 'accessible' to the internal environment – and, potentially, to the occupants.

Using the accessible thermal mass to store heat or 'coolth' – that is, by its surface temperature being respectively above or below the room temperature – will allow the surface to exchange heat with the room, and it occupants and contents, by convection and radiation. If this is synchronised properly – for example, by using cool night-time ventilation to re-cool an exposed concrete soffit that has absorbed heat during the daytime – then this exchange of heat will not only reduce the cooling (or heating) loads, but can also contribute to occupant comfort.

The influences of all the coincident internal heating and cooling loads, infiltration and movement of air, transmittance of heat through the structure and solar radiation passing through translucent surfaces – as well as the heat transfer into the thermal mass of the room – combine (alongside humidity) with the HVAC systems to produce an internal environment that determines whether occupants are thermally comfortable.

Acoustic internal environment

Room acoustics are complex, and it is likely that professional acousticians will be required to undertake a properly considered design. However, there are general principles that can help the professional lighter or building services engineer to understand the underlying issues.

As discussed more fully in the *CIBSE Journal* CPD article in May 2016, the actual strength of a particular sound felt by the ear is related to the sound pressure, p (Pa), that is the amplitude (magnitude) of the sound wave. For convenience, the sound magnitude is typically converted to a relative measure known as sound pressure level (dB) that

Location	Reverberation time(s)
Outdoors	0.0
Average bedroom/living room	0.4
Theatre for speech	0.9
New Glyndebourne Opera House	1.3
St David's Hall Cardiff (concert hall)	2.1
Symphony Hall Birmingham (concert hall)	2.4
St Paul's Cathedral	13

Table 2: Some typical and measured reverberation times[1]

Figure 1: Simple planar baffles suspended from a soffit, arranged with adjacent 'baffle' LED luminaire (Source: Spectral)

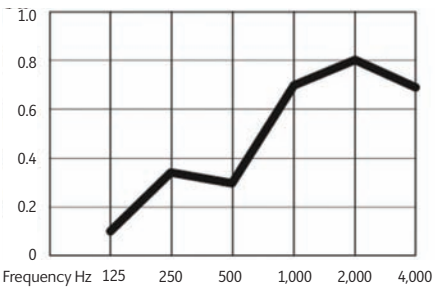

Figure 2: Sound-absorption coefficient – for example individual wire-suspended 200mm-deep baffle at 300mm centres, with 100mm clearance above baffle to soffit (Source: Spectral)

relates a sound to a standardised threshold of human hearing. In an open space, the sound pressure will halve as the distance from the sound source is doubled – as the noise is spreading across an area 4π x distance;[1] the reduction with distance is somewhat less in a room, because of its reflecting surfaces.

The frequency of the sound will have a significant effect on the perceived noise. Typically, human hearing is most sensitive to frequencies in the range of 3.5 to 4 kHz.[2] Most sounds are made of many frequencies, but there is likely to be a dominant frequency. Low-frequency noise – such as mains electrical hum with a fundamental frequency of 50 Hz or 60 Hz, depending on global location – would need to have a sound pressure level of 40dB to be just audible, whereas a 1,000Hz sound would have to be only a few dB to be heard. The spoken word is in the range of 300Hz to 3.5kHz – consonants have most of their energy above 1kHz and are important for intelligibility. As with all real-world sounds, there are harmonics (multiples of the fundamental frequencies) included in the voice that provide a more complete sound.

The reflection of sound produces an important part of the soundscape for the listener and can enhance, or diminish, the sound clarity and their ability to hear – for example – conversation. Reflected sound accumulates to produce 'reverberant' sound. The early reflections – being received by the listener in less than approximately 50ms – reinforce the direct sound signal and assist in sound clarity. Then, as the time delay increases, the reflected sounds will tend to mask the original sound.

The reverberation time is used as a simple indicator of a room's acoustic performance in relation to the reflection of sound from surfaces. As found by Wallace Clement Sabine at Harvard University at the end of the 19th century, reverberation time is proportional to room dimensions and inversely proportional to the amount of absorption present.[3]

Sabine empirically developed the commonly applied formula: room reverberation time (RT) in seconds for 60dB decay in sound (at 20°C) = $0.161\ V/(\sum S_i \alpha_i)$, where V is the room volume (m^3), S_i is the area of each of the surfaces (m^2), and α_i is the absorption coefficient of a surface of area S_i.

It calculates an estimation of the time required for the level of an impulse sound to decay by 60dB – frequency-dependent, it is a commonly used metric in the assessment of the internal acoustic environment. So, for example, a large space with tiled floors and a plastered ceiling will have a long RT, whereas a small room with a low suspended ceiling and thick piled carpet will have a much shorter RT. A reverberant room gives a higher overall sound level than a room with added sound absorption.

In spaces where speech is important – such as in an office or school – short reverberation times (around 0.6 to 0.8 seconds) are typical to ensure clarity and high speech intelligibility, whereas in large halls designed for music, much longer reverberation times are appropriate –or, in some cases, a matter of circumstance, as in St Paul's Cathedral (noted in Table 2). Speech generated in a space with a reverberation time much longer than 0.8 seconds can be difficult to understand.

It is important to note that, according to

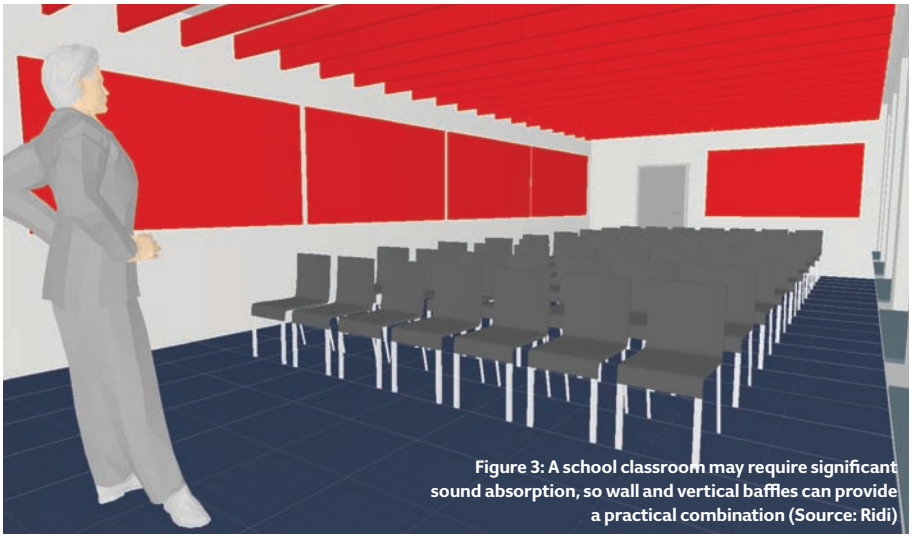

Figure 3: A school classroom may require significant sound absorption, so wall and vertical baffles can provide a practical combination (Source: Ridi)

BS 3882 *Acoustics – Measurement of room acoustic parameters – Part 1: Performance spaces (ISO 3382-1:2009)*, the reverberation time of a room was once regarded as the predominant indicator of its acoustical properties but – while it is still significant – there are other types of measurements that are needed for a more complete evaluation of the acoustical quality of rooms. These other factors are beyond of the scope of this article, but they emphasise the need for the input of a professional acoustician when assessing the acoustic performance of a space.

Creating a well-lit, thermally stable and aurally comfortable room

In many commercial and institutional applications, the ceiling has historically been the principal acoustic absorber for the space. However, this can create a dilemma where the soffit is also being used for its potential thermal mass. Typically, thermally insulating materials – such as ceiling tiles – that introduce good sound-absorbing characteristics, eliminate useful access to the thermal mass offered by the soffit.

Additionally, the area of the ceiling is simply limited to the plan dimensions, so the maximum amount of absorptive material will be determined by that area. If there are other constraints – such as roof lights, sprinklers, sensors, loudspeakers and downlighters – these will reduce that available area further. To help solve this, the acoustic baffle has evolved. This is a purpose-made element that can be suspended from, or fixed to, the soffit, creating an area of selectively absorptive material – a simple suspended 200mm-deep baffle is shown in Figure 1. Manufacturers design the baffles in

Figure 4: The baffle luminaires are mounted to match the acoustic baffles, while allowing the ventilation diffusers to pass between the ranks of baffles (Source: Spectral)

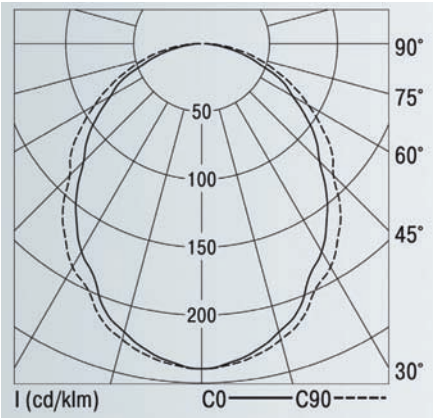

Figure 5: Example photometric polar curve for linear LED baffle luminaire (Source: Spectral)

conjunction with laboratory tests, to establish their performance in specific mounting positions. As an example, the data in Figure 2 is for the baffle shown in the photo.

Baffles can provide a high sound-absorption coefficient, as all the surfaces will absorb sound and – when they are hung from a ceiling – sound will also reflect off the soffit onto the panel. Their orientation will alter their effect; for example, if a teacher is positioned at one end of a classroom – as in Figure 3 – baffles mounted across the space would have a greater effect than if they were mounted in line with the teacher's line of sight.

When baffles are installed, the soffit is still partially visible to the occupants and so maintains the potential for some direct radiant heat exchange. The distance between baffles would typically be a 1:1.5 ratio, based on their depth – so a 300mm-deep baffle would be mounted at 450mm centres.

The manufacturers[4] report that a vertical panel arrangement will maintain thermal exchange with a concrete soffit (by radiation and convection), with a typical reduction of 3% in cooling potential, compared with a fully exposed soffit. The baffles themselves have little thermal mass.

It is possible to suspend luminaires in between the simple baffles, or to use carefully located downlighters – or daylight through rooflights – to ensure general illuminance. In some situations, this may not always yield a technically practical or aesthetically acceptable solution.

To offer an alternative (as shown in Figure 4), the general lighting can be afforded by LED luminaire systems manufactured to the same dimensions as the acoustic baffle. This can be a combined light and acoustic solution that still allows access to thermal mass.

The linear LED luminaires give an output comparable to modern fluorescent fittings, but with the attributes of LED lighting. Currently available outputs are approximately 1,600lm·m^{-1} to 2,300lm·m^{-1} (high efficiency to high output lamp), with an example light distribution – that will be lamp- and luminaire-dependent – as shown in Figure 5.

Further reading – **all available as PDF downloads:**

CIBSE Guide A1, 2016, chapter 5, provides greater detail on the application of thermal mass.

Building Bulletin 93, 2015 – *Acoustic design of schools: performance standards*, 2015, published by DfE/EFA, is an excellent primer on acoustic requirements for a wide variety of spaces.

The SLL Lighting Handbook, 2009, alongside the SLL Code for Lighting, 2012, published by SLL/CIBSE, compile comprehensive coverage of lighting design fundamentals.

References:

1 **www.acoustics.salford.ac.uk/acoustics_info/concert_hall_acoustics** – accessed 6 November 2016.

2 **hyperphysics.phy-astr.gsu.edu** – accessed 8 November 2016.

3 Sabine, W C, *Collected papers in acoustics*, Harvard University Press, 1923.

4 Estell, J, *Designing lighting with acoustics*, available from Ridi.

Turn over page to complete module

Module 103

December 2016

RIDI

1. Which of the following is likely to have the lowest thermal mass?

- ☐ A **Brick**
- ☐ B **Cast concrete**
- ☐ C **Dense plaster**
- ☐ D **Polyurethane foam**
- ☐ E **Timber**

2. What is the reverberation time quoted for St David's Hall, Cardiff?

- ☐ A **0.4s**
- ☐ B **0.9s**
- ☐ C **1.3s**
- ☐ D **2.1s**
- ☐ E **2.4s**

3. The human ear is likely to be most sensitive to which of these frequencies?

- ☐ A **4 Hz**
- ☐ B **40 Hz**
- ☐ C **400 Hz**
- ☐ D **4 kHz**
- ☐ E **40 kHz**

4. Which of these is least likely to be an attribute of applying suspended acoustic baffles, as described in this article?

- ☐ A **Their layout can readily be integrated with LED lighting**
- ☐ B **They allow a view of the soffit from the room below**
- ☐ C **They provide a larger area for sound absorption than the ceiling area from which they are suspended**
- ☐ D **They will probably reduce soffit-cooling potential by a few per cent**
- ☐ E **They will significantly increase the room thermal mass**

5. What was the approximate output of the high-efficiency linear LED luminaire, as mentioned in the article?

- ☐ A **600 $lm \cdot m^{-1}$**
- ☐ B **800 $lm \cdot m^{-1}$**
- ☐ C **1,200 $lm \cdot m^{-1}$**
- ☐ D **1,600 $lm \cdot m^{-1}$**
- ☐ E **2,000 $lm \cdot m^{-1}$**

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This month: Remote monitoring at the South Pole; LG14 overview; commercial – and underfloor – heating controls

LIFE SUPPORT

The facilities team at the British Antarctic Survey are responsible for maintaining heat and power in some of the most isolated buildings on Earth. **Alex Smith** finds out how remote monitoring and controls are ensuring the welfare of staff and scientists living near the South Pole


Rothera Research Station, Adelaide Island

People's lives depend on Chris Martin doing his job properly. As the facility engineer manager at the British Antarctic Survey (BAS), he – and his colleagues – supply heat, power, water and sanitisation services for scientists working in one of the most inhospitable environments on Earth.

His team oversee facilities at five UK research stations in Antarctica and the South Atlantic including Halley VI, which is built on the constantly shifting, 250m-thick Brunt ice shelf in Halley Bay. Here temperatures can plunge to -56°C and occupants experience 24-hour darkness for 105 days a year.

Failure of the building services is not an option in the winter (March to November) as sea ice makes Halley VI virtually impossible to access from the outside world. 'It's easier to evacuate a space station than to get someone out of Halley in the middle of winter,' says Martin. 'You can't get a ship near because of the sea ice, and you can't fly in because it's pitch black and you have no airport equipment. You'd be landing blind on an uneven surface, and you'd be heavily dependent on the weather.'

This isolation and harsh environment drive BAS's building and maintenance strategy. Equipment must be reliable and fixable, and must have back-up in case of failure. Systems need to be energy efficient because there is a finite supply of marine gas oil and aviation fuel for the generators, and shipping in additional fuel – when it can be – is expensive. The facilities team must be able to monitor research stations remotely so that any issues can be identified and fixed before they become catastrophic.

Mission control

BAS's home base is in Cambridge, UK, and, from here, the facilities team monitors and controls services in its newer buildings – including Halley VI, the award-winning research station, built in 2012, that resembles a giant mechanical caterpillar on skis.

'Performance monitoring is key to how we operate because every drop of fuel has to be transported to the South Pole,' says Martin. 'We can't put another shilling in the meter; tanks of fuel can't be replenished until the following year. We can't be complacent – if we go below a metaphorical mark on the fuel tank, we have to come home. We've been close, but it's never happened.'

Cambridge has access to the building

Hydro power at King Edward Point

BAS maintain a hydro power plant at an existing dam to power facilities at King Edward Point. 'From an environmental perspective it was really good value, as we didn't have to construct a dam, with all that embedded concrete,' says Martin.

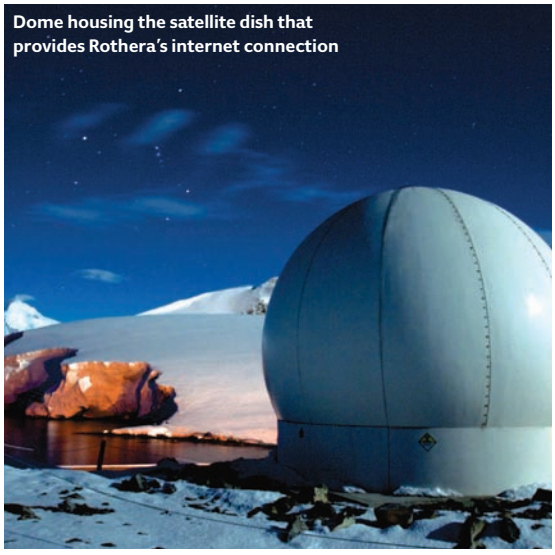
The hydro is not a finite resource though, and the team has to be careful not to drain the lake, which freezes in the winter, dropping from 98% to 76% volume. It will continue to run the hydro down to 25%. 'We still need to be considerate of the power being used,' says Meddle. 'We don't want to be blasé – we don't want lights dimming.'

The flow of water is controlled through the hydro so that the station only generates the power it needs: there is no grid to store unused energy. A control feedback mechanism, which reads power load and electrical frequency, is fed back to a spear valve – essentially a cone – which maintains the electrical frequency required.

'The control system is highly specialised,' says Meddle. 'It only uses water it needs, rather than peeling off an infinite supply of water and then wasting it.'

Staff and researchers enjoying Christmas dinner at King Edward Point

CREDIT ALASTAIR WILSON



Dome housing the satellite dish that provides Rothera's internet connection

CREDIT ADAM BRADLEY

management systems (BMS) at the larger buildings, so power and water usage. The team analyses the data from the HVAC systems to check which engines are running, and that the electrical loads are appropriate for the time of year.

'Spotting trends helps massively with maintenance,' says electrical services engineer Joe Meddle. 'For instance, we identified that waste heat from a server room was being ventilated adequately. Schneider Electric remotely helped the onsite electrical engineering technician to solve the problem by changing the damper settings.'

Electrical heat trace – which prevents water services equipment from freezing – can also be monitored using the satellite connection, so Cambridge can pick up on issues such as faulty thermostats changing the heating settings. 'It gives us an extra layer of confidence,' says Martin. 'The IT allows experts to identify problems remotely. The onsite generator mechanic is brilliant at fixing them, but we can remotely pull in resources from external companies who can help with specialist expertise. They can help us find efficient solutions.'

A close eye also needs to be kept on the loads of the legs that support the modules of Halley VI. A monitoring and control package is used to monitor the legs remotely. 'We can read the pressures and the weight,' says Martin. 'The ice shelf is quite dynamic. It's always moving. We need to know that the leg loads are balanced across the corner of each module. We keep those weights within tolerance – it's been a very reliable system.'

The team won't adjust the heating and ventilation services at Halley VI without first informing the occupants. 'We want them to feel in charge,' says Martin. 'They can see CO_2 and humidity levels, and they can deal with it themselves. The last thing you want them to feel is that Big Brother is watching.' BAS has experimented with renewables in the past, including three solar thermal

BRITISH ANTARCTIC RESEARCH STATIONS

1 Halley VI, Brunt ice shelf, Caird Coast
2 Rothera Research Station, Adelaide Island
3 Signy, South Orkney Islands
4 King Edward Point, South Georgia
5 Bird Island, South Georgia

systems and one PV array at Rothera. There is a very effective hydro-electric plant at King Edward Point, on South Georgia. Despite these renewables, the focus is always on boosting energy efficiency through fabric improvements or improvements to systems. 'The danger is that you focus purely on renewables before you tackle the older buildings that are not efficient,' says Meddle.

The use of solar panels is restricted. 'We can put them everywhere but, at Halley, you have 105 days of darkness a year, so you're limited to what you can do,' he adds. 'It's a unique environment; certain technologies don't work for our locations. We can have a wind turbine, for example, but you need a storage system and they need frequent replacing, and biosecurity restrictions limit what we can bring South.'

A combined heat and power (CHP) system, run on diesel, is the most robust source of heat and power, says Meddle, and can adequately meet the heat and hot water requirements. 'Halley is so well insulated that we can utilise the excess heat, even in winter.' That waste heat is used to melt snow for drinking. BAS's other usable, natural resource, at Rothera, is sea water – and reverse osmosis ensures that occupants have potable water. The station saves more energy by using untreated sea water to flush toilets.

Increased energy efficiency comes from upgrading equipment, such as the latest fuel-injection systems in the Halley CHP plant, and the engine replacements being carried out in smaller stations this year. However, this sophisticated technology means carrying more inventory and training more people.

New facilities are well insulated, so need little heating. The standard materials are structural insulated panels on a steel frame. Halley VI was built using fibre-glass composite panels, with a special resin to endure -56°C temperatures and high winds. Structures have to be airtight because of the freezing air and risk of snow ingress, so the team had to design an air intake that stopped snow from drifting in. Martin describes it as similar to a balanced flue on an old-fashioned boiler that can work in neutral conditions.

'Trying to start a generator from cold at those temperatures will damage it,' says Meddle. 'The standby generator has to be kept warm in case it has to be turned on.'

Martin will be at Halley during the short summer – around December to March – to help move the station to the other side of a growing crevasse; if the station stays where it is, its link to the mainland risks being cut off. This will mean disconnecting the eight modules so they can be pulled on their skis, and scientists and BAS staff will be moved to accommodation used in the summer. Two generators have already been shipped over, so that power can be switched from one to another by an onsite engineer. This is critical where extreme weather may prevent technicians spending much time working outside, even though the generator is probably 30m away. A 30-knot wind is the maximum at which staff are allowed to work outside, and conditions such as this can prevail for a week. Factor in the darkness, and it is easy to understand why handlines are used to guide staff between buildings.


Halley VI

CREDIT ANTONY DUBBER


RRS Sir David Attenborough will replace two existing vessels

> Performance monitoring is key. Tanks of fuel can't be replenished until the following year. If we go below a metaphorical mark, we have to come home

Every summer, members of Martin's team visit the research stations to maintain buildings or erect new facilities. A typical contract at Halley might be four to six months and, in the winter, longer – ships leaving in March don't return until December. There are three technicians permanently onsite at Halley and Rothera, each specialising in electrical services, mechanical services or power generation. On the smaller sites, there is only one. 'We aim for multidisciplinary engineers,' says Martin. 'Marine engineers are ideal because they have to deal with everything – refrigeration, water-making, power generation, and health and safety.'

A new face

Currently, two ships send suppliers to the research stations, but *RRS Ernest Shackleton* and *RRS James Clark Ross* will soon be replaced by a new vessel – *RSS Sir David Attenborough*. A public vote called for the ship be named Boaty McBoatface, but – as it was non-binding, the Natural Environment Research Council was able instead to honour the broadcaster and naturalist.

Using just one ship will help BAS cut its carbon emissions. The more advanced vessel will also have greater ice-breaking capabilities and serve as a logistical support vessel for teams at inshore locations. But having only one ship will mean potentially fewer visits to the research stations, so fuel will become more precious and performance even more critical.

The facilities team all spend time on the stations, which helps them to understand the condition of the HVAC systems, and plan and design for the future. Martin looks forward to his stints 'South': 'Some people might struggle with the isolation, but I enjoy the environment and the group living.'

As the people in charge of heat and power 'there is a lot of responsibility providing the life-support system for the other occupants' – but Meddle and Martin relish their roles, and the unique challenges of commuting between Cambridge and the Antarctic. 'It's the best job in the world,' says Meddle. **CJ**

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GUIDING LIGHT

The Society of Light and Lighting has published its latest guidance on controls – LG14. **Sophie Parry**, SLL technical committee chair, summarises the new document

LG14 *Control of electric lighting* sets out a logical approach for the designer to consider the consultation, design, specification, commissioning and handover of a lighting installation incorporating controls. The guide also acknowledges new luminaire and controls technologies, some of which have yet to prove themselves and become commonplace in the built environment.

Following an introduction in **Chapter 1**, there is an overview of the terminology used in lighting controls in **Chapter 2**, covering:

- Frequently encountered acronyms, with brief explanations
- Modes of operation, such as manual control, presence detection, absence detection, photo cells and scene-setting
- Design features, including daylight linking and constant illuminance control
- Dimming and regulation.

Chapter 3 looks at the approach to designing and developing a lighting controls specification by understanding: the space; client preferences/expectations; and the development of the lighting scheme. It concludes with a list of key aspects that need to be considered, discussed and noted to manage the project expectation, and apply the resultant brief to the lighting design.

Chapter 4 offers food for thought on human interaction with lighting controls. Information is given on how lighting controls can be applied by end users, rather than accepting a set operating configuration that – in many cases – is automated, with no scope for localised manual control or adjustment.

The guide covers lighting for architectural enhancement

Chapter 5 covers lighting for visual effect and comfort – a part of design that most people don't instinctively associate with lighting controls, because not all controls applications are designed with the prime purpose of conserving lighting energy. The main areas covered include:

- Lighting for architectural enhancement and effect: the artistic side of control
- Presentation spaces – such as classrooms and lecture theatres – in which wall-screen glare can create a poor and inefficient learning experience for students
- Circadian lighting, where a compatible control system is used to shift the colour of white electric light to emulate the colour changes of daylight, serving the emerging benefits of lighting for health and wellbeing.

Chapter 6 examines energy reduction through lighting control. This is probably the main – and only – reason most people believe lighting controls are a project requirement. Well-designed automatic lighting controls can contribute significantly to lighting energy reduction; however, putting this chapter more than halfway through the guide, emphasises that the subject of controls is more than just about efficiency.

Chapter 7 is concerned with integrated systems, and looks at the interfacing of lighting control devices through a dedicated network. Also covered is the subsequent information-sharing with other networks, such as building management systems. Another application for consideration is the incorporation of automatic testing/monitoring of emergency lighting through a lighting control system. The chapter concludes with a few notes on the emerging subjects of Power over Ethernet (PoE) lighting and controls, and the use of the internet as a communications pathway.

Chapter 8 examines system commissioning and handover. It explores the – often overlooked – requirement to ensure that lighting controls are optimised for energy reduction where this is a design requirement. It also goes through the project handover process to ensure the end user understands the process behind – and the benefit of – the installed lighting controls.

The Society of Light and Lighting guide concludes with several case studies for common lighting-control applications, such as places of worship, classrooms, offices and highways lighting. **CJ**

- Download LG14 at **www.cibse.org/sll**

SOPHIE PARRY is key accounts manager at Zumtobel Group, and chair of the SLL technical and publications committee

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INTELLIGENCE LINKS

More insulation and lower heat loads mean underfloor heating controls have to be far more sophisticated to avoid overshooting setpoints. SIG's **Mat Norris** explains

The requirement for increased insulation in homes has significantly reduced heating loads. As a result, control systems must be more accurate to avoid excessive heating, and the consequent overshoot in room temperatures that can occur when using simple room thermostats.

Manufacturers of underfloor heating systems are working closely with controls developers to deliver floor temperatures that not only create the required comfort conditions for occupants, but also protect materials susceptible to heat – such as timber floors – by monitoring and controlling surface temperatures.

Fusi, an example of such a system, can accommodate multiple daily operating periods for each zone, managed by a central touch-screen controller, with heating and – where available – cooling controlled from a single room sensor.

Room controllers, embedded with the room sensor, include adaptive, self-learning control that adjusts to the response rate of each room or zone. As the room approaches the setpoint, the control modulates the supply of heating water to the floor coils by gradually reducing the heat output until setpoint is achieved. It then increases the output intermittently, as required, to maintain the setpoint temperature.

Wall sensors would be placed on an internal wall, ideally out of the way of any external heating/cooling sources and direct sunlight.

The system uses a floor sensor for timber floors – typically set to a maximum of 27°C and adjustable to suit manufacturers' specifications – to prevent overheating. It overrides the air sensor to ensure protection of the fabric. The floor sensors are mounted in a conduit, equidistant between flow/return pipe loops, so it is in contact with the underside of the sub-floor, made up of chipboard or cementitious boards.

An embedded optimum start controller ensures that the room reaches setpoint at the required time, without the occupant having to guess what time the heating should be switched on at the start of each day. Web-based remote access can be used to schedule and adjust setpoints.

The utility cupboard in the Fusi system is assembled off site and contains the controller and HVAC plant

In high-rise, residential developments, outside weather compensation is usually managed in the central plantroom. If, however, outside weather compensation is required on individual zones, it can be accommodated with the use of additional sensors, plus 0-10V modulating mixing valves.

Reduced errors

Off-site pre-formed 'utility cupboard' control packages can be pre-wired and fully tested in the factory. This enables the use of standardised components, a reduced onsite construction programme, and preconfiguring and testing. It also reduces installation errors. A package would typically include a controller with configurable relays to manage the underfloor heating actuators, valves and pumps.

Such a controller can also include the control required for other heating/cooling components – such as fan coil units (FCUs) for heating and/or cooling – and can include fan coil unit speed control for multiple FCUs in multi-zone applications.

Using standard control protocols – such as Modbus – these systems can integrate with variable refrigerant flow (VRF) and variable refrigerant volume (VRV) units to provide a complete system that will operate together effectively.

Preconfigured maintenance regimes can be used to operate the pump and valves – and maintain flow through the heating and cooling systems when it would not necessarily be operating – to reduce later operating problems and overall maintenance requirements.

Outside of preconfigured maintenance, integrated diagnostic systems can be used to alert users to faults at the central touch-screen.

By integrating purpose-designed controllers – and through the use of prefabricated control units – such systems can offer effective and maintainable mixed-mode heating and cooling systems, and protect the building's fabric in modern, highly insulated, construction.

● **MAT NORRIS** is business development manager at SIG Performance Technology

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THE CHANGING FACE OF CONTROLS

Commercial heating controls are being adapted to give building operators and energy managers easier control over energy consumption, says Remeha's **Adrian Morris**

Heating systems are capable of very high efficiencies. Commercial condensing boilers are no exception, with many claiming 98% gross calorific value. But such efficiencies can only be fully realised if the boilers are properly controlled. If controls are not usable, there will be no reduction in energy demand, operating costs or carbon emissions.

Historically, commercial controls have not been perceived as very user-friendly. The challenge for manufacturers is to design panels that make it straightforward for building operators to manage their boilers so they can more appropriately control the systems and reduce energy use.

Research by Remeha in seven European countries revealed that there was scope for improvement in the way user groups interacted with control systems. 'This was due, in part, to the technology available at the time – but an additional factor was that the controls had mostly been designed by engineers and not by graphical user interface (GUI) experts,' says Evert de Boer, group product manager, controls, at BDR Thermea.

This inspired an idea to create a control platform – offered as standard – that is simple to use and has robust functionality to meet a wide range of purposes in most installations.

The panel display turns to red if there is a fault

Designed for installers and end users, the functionality – added via a smart connection board – is accessed and controlled using the visual display on the front of the boiler.

Users choose from one of the two entry-level options on the menu screen. Engineers can access the parameters they need to install, service or repair the boiler, for example: fault history, to help with maintenance; fan speed, for commissioning, because this is used to measure the output of the boiler; and boiler run hours and number of starts. These can help diagnose particular faults – even if the engineer isn't familiar with a particular boiler.

At the same time, energy managers receive the appropriate information about temperatures, run hours and schedules.

Research underlined the importance of intuitive control for improved usability, so the control interface has been enlarged to make it more legible and easier to read in the dark.

If there is a fault, the interface changes from blue to red; previously, systems were backlit in white. With more room for information, plus a modern typeface, legibility and usability are improved. Four smart-key push buttons give access to the parameters that can be changed, simulating the experience of a smartphone for greater familiarity.

Previously, it was common for separate control components to be fitted at the time of the boiler installation, but time and temperature controls can now be integrated as a standard – and functionally superior – part of the boiler installation. The controller can then, for example, be connected directly to the building energy management system (BEMS).

Soon, there will be controls offering text description and infographics, zone control, and cascade control of multiple heating products. These will encourage predictive, rather than reactive, maintenance. The operating parameters will be monitored and, when maximums or minimums are approached, they will be flagged up before levels are exceeded and malfunction occurs.

If Wi-Fi connectivity – increasingly common in control communications – is lost, people will still be able to adjust or override the controls manually. Control must, ultimately, lie in the hands of the user. **CJ**

ADRIAN MORRIS is product manager at Remeha

Monodraught HTM is an ideal solution for school buildings, particularly those that are part of the PSBP2 programme. It is specially suitable for schools that are looking for a cost-effective ventilation solution that fulfils building regulation requirements.

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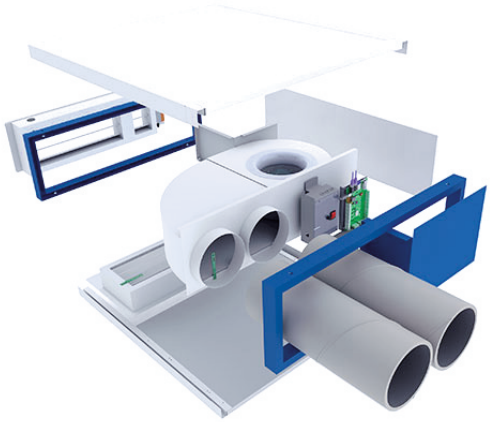

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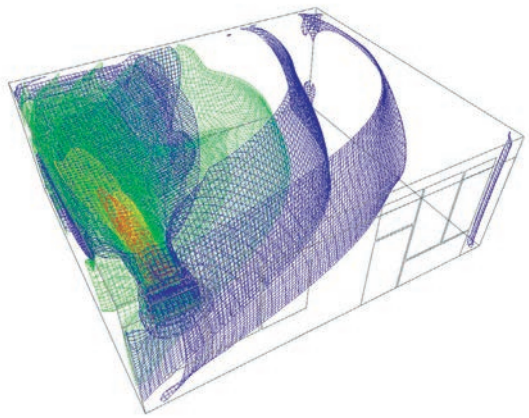

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Hybrid ventilation for schools

This CPD explores different types of ventilation solutions, focusing on hybrid – or 'mixed mode' – systems and their application in the education sector

Local authorities project that, by 2020, an extra 366,000 primary school pupils and an additional 362,000 secondary school pupils will be in education in the UK, compared with current numbers.[1] To accommodate this, the focus is likely to be on an accelerated school building scheme, including the 277 schools that will have at least one of their buildings – or blocks – rebuilt or refurbished through phase two of the Priority School Building Programme (PSBP2). Ventilation is a critical element of new school design and existing school redesign. The regulatory imperative is to make sure that education spaces are well ventilated, and that the air quality in classrooms is appropriate for staff and students, so providing healthy and comfortable spaces.

This module will consider the different types of ventilation available, with a focus on hybrid – or 'mixed mode' – ventilation and its application in the education sector.

The first stage of PSBP addressed the demands of schools that were in need of urgent repair. In 2014, the programme evolved to undertake rebuilding and refurbishment projects across 277 schools and sixth-form colleges between 2015 and 2021.[2] The PSBP aims to produce teaching spaces that meet the new adaptive thermal comfort standards, to avoid summertime overheating, maintain carbon dioxide (CO_2) concentration criteria for adequate indoor air quality (IAQ) in classrooms, and ensure that the environment is controllable by building users.

Figure 1: The active component of a hybrid ventilation system (Source: Monodraught)

Setting the design standards for school ventilation

The guideline that has been developed to define ventilation conditions in UK schools is Building Bulletin 101 (BB101), which was last published in 2006 and is currently being updated (a consultation version was released earlier this year[3]). Since 2006, the Education Funding Agency (EFA) has commissioned a set of baseline designs and strategies for schools[4], specifically aimed at meeting the EFA's services output specification. These provide useful reference ventilation scheme designs for different school applications, and are based on achieving healthy and comfortable spaces, as defined by design parameters that draw on current legislation, standards and guidelines. The thermal comfort criteria are based on the adaptive thermal comfort standards for free-running buildings outside the heating season, as covered in CIBSE TM 52 *The limits of thermal comfort: avoiding overheating in European buildings*, and CIBSE Guide A.

The consultation version of the 2016 BB101 includes updates to thermal comfort criteria that adopt the adaptive comfort criteria. Previously, air (dry bulb) temperature alone was used as an indicator of comfort, whereas the new requirements are based around operative temperature. This more closely tracks the total heat exchange that occurs between occupants and their surroundings.

The proposed BB101 has unaltered targets for levels of CO_2 in teaching spaces, but with some relaxation where outdoor CO_2 levels are high. Minimum recommended outdoor air supply rates appear to be unchanged from the previous version, but the air quality criteria – which cover internally and externally derived pollutants – have been updated in line with international recommendations.

Methods of ventilation

Natural ventilation – driven by natural buoyancy or wind pressure – would, traditionally, have been the standard solution for school buildings, and has generally been suitable for normally occupied buildings located in mild or moderate climates. Typically, it would mean openable windows, or purpose-made natural ventilation openings and ventilation chimneys with manually operated dampers. This creates no fan or system noise and requires minimum maintenance. However, in more extreme weather or occupancy conditions, the space may be deemed unacceptable because there are limited control options – for example, opening or closing windows. There are often limitations on the depth of room that may be naturally ventilated successfully using passive means of moving air, and – depending on the external environment – there are potential challenges with noise, particulate matter and rain ingress.

Mechanical ventilation provides a controlled supply (and, normally, extract) airflow, enabling a basic control of room temperature, humidity and air quality. The systems can be simply designed to allow local control – installing a responsive system using automatic or manual controls – and to deliver reasonable thermal effectiveness via simple heat exchangers.

A hybrid – or 'mixed mode' – ventilation system allows the controlled introduction of outdoor air ventilation into a building by both mechanical and passive means. Controls play an important role, allowing the system to switch between the two types of ventilation based on a set of operating parameters. The built-in controls allow the mechanical and passive systems to work together, so as not to cause additional ventilation loads compared with using mechanical ventilation alone – or, indeed, causing one system to 'fight' the other. The EFA's baseline-design documentation for ventilation explicitly notes the concern that the energy efficiency of naturally ventilated buildings may be compromised because of the inability to recover heat while introducing outside air in winter.

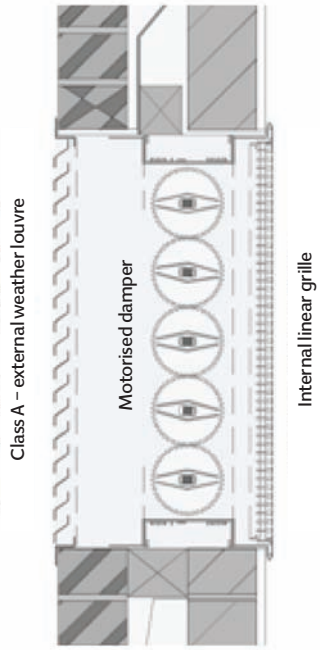

Figure 2: Façade ventilation system (Source: Monodraught)

Application of hybrid ventilation

Natural ventilation is not able to supply sufficient indoor air quality in many classrooms because of, for example, room depth, occupant density, obstructions or noise. So improved conditions can be obtained with a hybrid ventilation strategy – such as that shown in Figure 1 – combining the advantages of natural and mechanical ventilation.

During occupied periods of the non-heating season, the system works in conjunction with additional openings to the external façade of the room, to increase the availability of controlled outdoor air supply.

These façade ventilation systems typically comprise an external aluminium louvre, a high-specification volume control damper and an internal grille – as shown in the façade ventilator in Figure 2 – and can create a more secure option than using windows. They can act solely as an exhaust and, if sized and controlled appropriately, can offer a low-resistance air path that may be used for night-time purge ventilation. Depending on their location within a room, they can assist in automatically controlled stack, cross-flow and single-sided ventilation. The dampers can also be opened and closed manually using the systems control panel.

A typical classroom installation would include the main hybrid ventilation system – which would contain a fan, mixing box and controls – plus ventilation intake and exhaust, and some kind of control interface.

A suitable control strategy (and interface) is needed to meet the needs of the diverse users who are likely to operate the system – from building and facility managers through to teachers and students. Touchscreen controllers that offer a graphical interpretation of the operation of the ventilation system are available. Through such interfaces, a relatively casual user can explore how the systems work, adjust settings, and find out information on the system to maintain a comfortable environment, while – in the background – it automatically operates to maintain the most effective operating mode.

The EFA considers that the automatic control system for such hybrid-ventilation products maximise natural ventilation provision, and only use mechanical ventilation when the room conditions are not met by natural means. As such, they are considered as natural ventilation systems for the purposes of limiting the concentrations of CO_2.

Figure 3 illustrates the simple operating principle of a hybrid ventilation system applied to a room with single-sided ventilation.

Building simulation

As with any building services system,

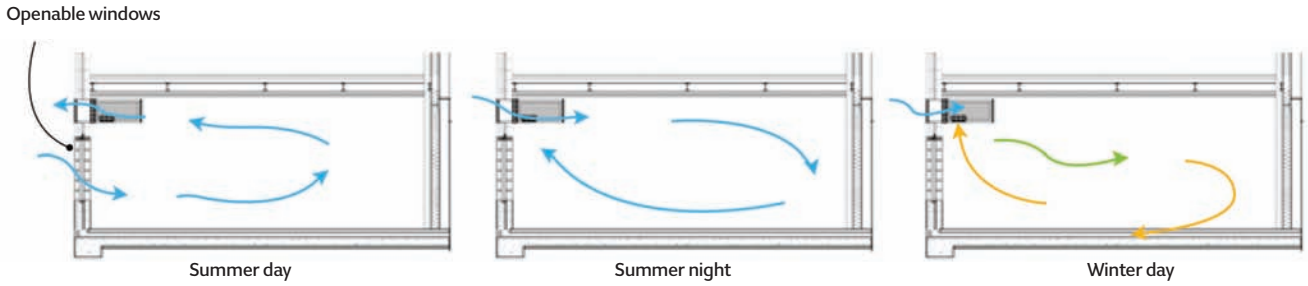

Figure 3: Example of operating modes for single-sided hybrid ventilation system (Source: Monodraught)

appropriate planning should be carried out in advance of implementation. Building simulation tools allow the sensitivity analysis of parameters – such as size of the room, opening positions, external conditions and occupancy patterns – with the different methods of ventilation. Computational fluid dynamics (CFD) can be used in building design to model the movement and temperature of air within spaces. CFD simulation – typically informed by dynamic thermal simulation – that includes a prediction of outdoor wind patterns and temperatures is used to simulate indoor airflow, and is a key tool for the design and evaluation of hybrid ventilation for buildings. CFD is combined with thermal models to simulate such things as:

- Internal temperatures
- Room-air velocities
- Air-change rates
- Air quality (specifically CO_2 concentrations)

so that it can be used to inform predictions of energy use and costs of operation.

Useful CFD modelling is still a skilled and specialist activity. However, increasingly, there are CFD modules – developed with system manufacturers – that, when combined with commonly applied commercial thermal modelling software, can supply well-tuned predictions of the opportunity for continuously regulated flow of natural ventilation. So, for example, by applying CFD and thermal models for hybrid ventilation systems in buildings with typical occupancies in the UK, it has been shown that – at an outside air temperature of 0°C – it is possible to provide a supply of air into the room at approximately 13°C.

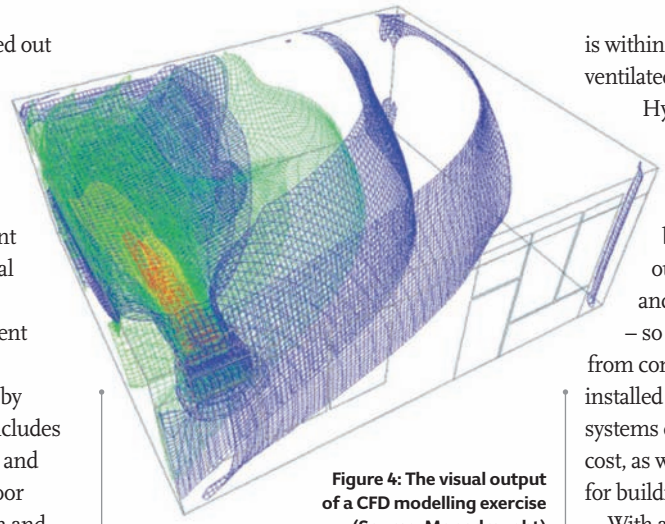

Figure 4: The visual output of a CFD modelling exercise (Source: Monodraught)

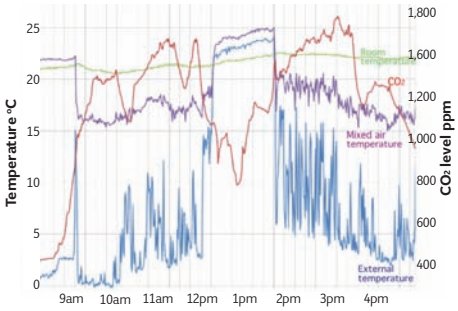

Figure 5: Measurements from Thomas Hickman School data during sample spring day when fully occupied (Source: Monodraught)

Meeting the needs of the PSBP and beyond

A system installed in 2014 – in an east-facing classroom measuring 5m x 9m x 3.2m, with 7m x 2m fixed glazing (excessive external noise prevented operable windows) – was monitored for a year. An example of a spring day's operation is given in Figure 5, which indicates the room temperature, CO_2 concentration, and fan and damper operation. Typical spring and winter data is summarised in Tables 1 and 2 for an occupancy of 30 students and two teachers. For the more demanding winter case, the average room temperature was 22°C and the average CO_2 level was maintained at 1,300 ppm[5] – which is within the BB101 limits for a naturally ventilated system.

Hybrid ventilation offers a potential solution to meet the requirements of projects that fall under the second phase of PSBP. It can potentially be an energy-efficient way to supply outdoor air ventilation to buildings and, in some conditions, to cool them – so reducing energy otherwise required from conventional sources. When designed, installed and controlled appropriately, these systems can deliver a lower building life-cycle cost, as well as create a healthy environment for building occupants.

With appropriate modelling, the system can be developed to operate effectively throughout the year. During the winter months, it can continue to maintain good CO_2 levels while mixing outdoor and recirculated room air to ensure air is supplied at a moderate temperature. With appropriate controls and interfaces, the building manager can ensure that the system is operating as it should, and end users can be given guidance on the correct action to take for optimum performance.

It can also create a greater sense of occupant satisfaction, because of their increased ability to exercise control over the ventilation provided.

Winter day	Max	Min	Average
Room temperature	23°C	21°C	22°C
External temperature	7°C	0°C	5°C
Mixed air temperature	25°C	15°C	19°C
CO_2 concentration	1,780ppm	425ppm	1,300ppm

Table 1: The performance of the hybrid system on a typical winter day[5]

Spring day	Max	Min	Average
Room temperature	24°C	21°C	23°C
External temperature	17°C	6°C	13°C
Mixed air temperature	24°C	13°C	20°C
CO_2 concentration	1,580ppm	505ppm	1,145ppm

Table 2: The performance of the hybrid system on a typical spring day[5]

Further reading:

CIBSE AM10 assembles excellent foundation and application of natural ventilation.

CIBSE AM 11 covers building performance modelling – particularly chapter 6, for ventilation.

CIBSE AM13 *Mixed mode ventilation systems* compiles fundamental knowledge in 'hybrid' systems.

www.hybvent.civil.aau.dk holds the collection of work from an International Energy Agency project on hybrid ventilation from 2002 – most of which is still relevant today.

References:

1 *The School Places Challenge*, **www.scapegroup.co.uk/research** – accessed 2 November 2016.

2 **www.gov.uk/government/collections/priority-school-building-programme-psbp** – accessed 4 November 2016.

3 **https://consult.education.gov.uk/capital/bb101-school-design-iaq-comfort-and-ventilation** – accessed 4 November 2016.

4 **www.gov.uk/government/publications/psbp-baseline-designs** – accessed 4 November 2016.

5 Hybrid Thermal Mixing Ventilation Systems, **www.monodraught.com/documents/downloads/download_363.pdf** – accessed 4 November 2016.

Turn over page to complete module

Module 104

December 2016

Monodraught®
engineering delivered naturally

1. How many school premises are included in phase two of the Priority School Building Programme?

☐ A 52
☐ B 101
☐ C 277
☐ D 362
☐ E 366

2. In the example of the façade ventilation system described and pictured, what is not specifically included in the through-the-wall unit?

☐ A External weather louvre
☐ B Filter
☐ C Internal grille
☐ D Manual damper control through the control panel
☐ E Motorised damper

3. Which building bulletin is most appropriate to use to determine requirements for acceptable ventilation conditions in UK schools?

☐ A BB87
☐ B BB93
☐ C BB95
☐ D BB101
☐ E BB102

4. In the proposed update to the standard ventilation building bulletin, what is noted as being specifically amended to keep up with international standards?

☐ A CO_2 levels
☐ B Internal noise levels
☐ C Internal temperatures
☐ D Levels of internally and externally derived pollutants
☐ E Outdoor air supply rates

5. In the example given of the hybrid ventilation application in the classroom, what was the average CO_2 level on the example winter's day?

☐ A 425ppm
☐ B 505ppm
☐ C 1,300ppm
☐ D 1,580ppm
☐ E 1,780ppm

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Passive cooling thermal energy storage (TES)

Thermal energy storage (TES) is the temporary storage of thermal energy for later use. Overnight cool energy is stored in the form of 20~27ºC phase change material (PCM) filled containers and later used to absorb the internal and solar heat gains during the day, for an energy-free, passive cooling system. It offers environmentally friendly, short pay back, maintenance- and energy-free cooling, which can be applied to new or existing buildings.

● **Call 01733 245 511 or visit www.pcmproducts.net**

Aspen Pumps celebrates win at RAC cooling industry awards

Sussex-based Aspen Pumps has won a prestigious Cooling Industry Award for its innovative Micro-v i4.

This intelligent air conditioning (AC) condensate pump beat off extensive competition to win the Air Conditioning Product of the Year: Accessory, Component or Process category.

'We are delighted to have won an RAC Cooling Industry Award and have the Micro-v i4 recognised in this arena,' said Joe Rose, head of group marketing at Aspen Pumps.

● **Email sales@aspenpumps.com or visit www.aspenpumps.com**

Complete super-condensing system

Atlantic Boilers has provided six full heating and hot water systems for St James's Palace.

An important development has been the separate installation of the highly efficient heating and domestic hot water to the six principal apartments located around the Court.

The domestic hot water demands are met by six Atlantic Expresso plate heat exchanger-buffer vessel modules at minimum primary temperature – and backed-up by immersion heaters – to match peak demands easily and guarantee space condensing.

● **Email technicalsales@atlanticboilers.com or visit www.atlanticboilers.com**

Elco launches new CHP range

Elco Heating Solutions has introduced a new range of gas-fired combined heat and power (CHP) systems. It consists of four models with electrical outputs from 5kWel up to 50kWel and thermal outputs from 12.2kWth to 100kWth.

The range achieves an A++ energy efficiency rating, offering operators of commercial buildings financial and environmental benefits.

With integrated condensing units, all four models (S, M, M+ and L) have efficiencies up to 109.5%. They can all operate in parallel with grid connection, while model L can also run as a stand-alone unit without connection to the grid.

● **Visit www.elco.co.uk**

Big Foot Systems spreads the load at H&T Presspart

H&T Presspart has been supplied with a custom plant deck by Big Foot Systems so it can distribute the plant load across a lightweight roof consisting of rolled purlins, transferring them down to the structure without the need for penetrations.

With three sizes in stock and custom design, the frames offer fast installation. The system benefits from a wide base, making them stable in high-wind locations, which is often a design consideration with very tall units.

● **Call 01323 844 355 or email enquiry@bigfootsupport.com**

Climaveneta introduces flexible new range of water-cooled chillers

TX-W, the new water-cooled chiller range from Climaveneta, offers 63 possible combinations. The unit can host from one to six centrifugal oil-free compressors, plus six new couples of heat exchangers, which can be flexibly deployed with a horizontal or diagonal layout, according to the space requirements of the HVAC plant. Leaving water temperature up to 20°C makes TX-W the perfect solution for mission-critical applications and industrial processes.

The heart of the new chiller is the CX4 controller, featuring exclusive hardware and software that dynamically master all the main components and make them work at their best. In multiple compressor units, CX4 employs the exclusive 'jumping staging' logic, which always enables the most efficient combination of compressors.

Access to CX4 comes through a highly personalised touchscreen interface or via KIPlink, which allows direct access to the unit configuration from any mobile device.

● **Visit www.climaveneta.com**

Wet rooms benefit from elegance of Dallmer drainage channels

A high-specification refurbishment and extension at a residential property in west London has included installation of linear shower drains. Dallmer supplied two of its CeraLine W 800mm floor channels with CeraLine custom cover plates. In both cases, the floor drains – with adjustable ball-joint outlet connection – have a flow capacity of at least 48l/min.

The height-adjustable floor channels feature sound-absorbing levelling legs, and the drain body has an easily removable trap.

● **Call 01787 248 244, email info@dallmer.com or visit www.dallmer.com**

Flexible billing for residents at The Ladbroke Grove

Evinox Energy are working with P R Morson on supplying heat interface units (HIUs), metering and billing services to The Ladbroke Grove development from Taylor Wimpey Central London, part of the regeneration of Grand Union Centre.

To reduce the environmental impact of the development, the apartments are all connected to a communal heating system, which supplies residents with thermal energy for heating and production of domestic hot water.

System water is heated in a central plantroom, distributed via pipework around the building, and energy is transferred to residents via a ModuSat HIU.

At The Ladbroke Grove, the ModuSat HIUs include an energy meter for heating and hot water, and an electricity meter, so residents will be billed for both utilities by Evinox Energy.

Evinox ModuSat HIUs are supplied pre-payment or credit account ready, so there is no need for additional controls, sensors or hardware – providing flexible metering options.

● **Call + 44 (0)1372 722277 or visit www.evinoxenergy.co.uk**

Elco boilers set for new term

As part of the complete refurbishment of the plantroom at Horringer Court School in Bury St Edmunds, Suffolk, five Thision L EVO 140kW boilers from Elco have been installed.

The upgrade will offer the school improved efficiencies and long-term reliability thanks, in part, to the construction of the Elco boilers. The installed units are a re-engineered range of commercial boiler, offering powerful outputs from 60kW to 140kW. At the school, they are operating in a fully modulating cascade arrangement, with all five units sharing a new flue system.

● **Visit www.elco.co.uk**

Historic Manchester building adopts underfloor air conditioning

AET Flexible Space has been part of the phased refurbishment of 196 Deansgate in Manchester, an architecturally stunning building that has a Grade II-listed façade.

The AET Flexible Space system uses the plenum as the ventilation duct, but offers superior zonal control compared with standard underfloor air distribution.

As the system uses the space beneath the raised access floor to distribute conditioned air, this eliminates the need for ceiling-based ductwork and offers a variety of benefits, for example, allowing architectural features and ceilings to be left exposed.

● **Call 01432 310 400 or email lucy@flexiblespace.com**

Fire Design Solutions appointed to London skyscraper project

Fire Design Solutions (FDS) has been appointed to provide its expertise and range of systems for a new £110m residential development in London's Elephant and Castle district.

FDS will design, supply and install its smoke-ventilation systems for the main block and an additional six-storey terrace building. It will also provide ventilation systems to remove pollutants during day-to-day operation and smoke in the event of a fire.

FDS used computational fluid dynamics (CFD) modelling to simulate the movement of fire and smoke through the building in the event of a blaze, to validate the effectiveness of the mechanical smoke-ventilation systems.

Using ventilation shafts that incorporate powered fans to serve a building's common corridors and/or lobby areas, mechanical systems engage automatically when a fire is detected. They remove smoke to provide an escape route for the building's occupants, while also enabling access for the attending fire services.

● **Visit www.firedesignsolutions.com**

VAV control on Airflow's commercial MVHR range

Airflow Developments has added variable air volume (VAV) dampers to its Duplexvent range of commercial mechanical ventilation with heat recovery (MVHR) units.

VAV systems monitor the air volume supplied and shares this information with the ventilation unit. This ensures optimum air quality and comfort by allowing the ventilation to respond effectively to the demands of each area of the building. 'The VAV dampers ensure our MVHR units can respond swiftly and effectively to these changes in demand,' said Krzysztof Kwarciak, category product manager at Airflow Developments.

● **Visit www.airflow.com or follow @AirflowD on Twitter and Airflow Developments on Facebook**

Glazing manufacturing specialist – right on target

A Scottish glazing manufacturer proved to be in a league of its own when it won a Geze UK competition staged to celebrate the Euro 2016 football championship.

Charles Henshaw & Sons, of Edinburgh, correctly identified Spain as the winners of the 2012 title to win a table football machine.

The table will be donated to the Royal Hospital for Sick Children, in Edinburgh, which is being fitted with Geze doors in partnership with Charles Henshaw.

● **Call 01543 443 000 or visit www.geze.co.uk**

Grundfos get into the picture

An art gallery in central London was approached by Grundfos, which offered to do an energy check on its current pump set-up, to assess where and how any savings could be achieved.

Maintaining the correct atmosphere in an art gallery is about a lot more than simply ensuring visitor comfort; the paintings and artworks need a very exact atmosphere to keep them in peak condition.

Grundfos was delighted to be able to play an instrumental role in delivering the ideal environment to achieve this.

The results of its energy check highlighted some obsolescent pumps and the decision was quickly made by the gallery to replace them.

Pumps from the Grundfos NBE 65 range were selected. These electronically controlled, single-stage bloc pumps showed that an annual energy reduction of 21,900kWh could be achievable for an investment of just £5,500.

This would mean a return on investment in just two and a half years.

● **Call 01525 850 000, email grundfosuk@grundfos.com or visit www.grundfos.co.uk**

Mikrofill supply Stanbrook Abbey hotel

Energy Performance Solutions put together a design – including two new plantrooms – to upgrade the oil-fired, low pressure hot water (LPHW) heating and hot water system (HWS) circuits at Stanbrook Abbey hotel in Worcester.

Mikrofill supplied: two Ethos FS550kW twin burner condensing boilers; a Mikrofill 1400/2 pressurisation package; two Extreme 500 HWS loading cylinders with unvented kits; two WM70kW condensing boilers; a Mikrofill 150 pressurisation package; and one Extreme 500 HWS loading cylinder with unvented kit.

● **Call 0345 60 60 20 or visit www.mikrofill.com**

Pendock produces bespoke collars for vista apartment development

Telford-based manufacturer Pendock has produced 69 circular skirting collars for Berkeley Homes' new high-end property development project at Chelsea Bridge.

They are being installed around the base of 400mm- and 500mm-diameter concrete columns, to match the skirtings used throughout the 453 apartments.

Pendock – with its highly skilled in-house design teams – is well known for its bespoke solutions, and a spokesperson for Berkeley said: 'Nobody else seemed to offer a solution.'

● **Call 01952 580 590, email sales@pendock.co.uk or visit www.pendock.co.uk**

Jaga's heating and ventilation solution for Cheshire school

Silver Springs Primary Academy, Stalybridge, is benefiting from Jaga's oxygen system. This monitors and measures temperature and CO_2 levels in the six downstairs classrooms, and automatically draws fresh, clean air in, when required, to maintain indoor air quality.

The refresh units are built into Jaga's Guardian low surface temperature (LST) radiators, which feature the company's award-winning low-H_2O technology, offering energy savings of up to 16% compared with a standard steel-panel radiator.

● **Call 01531 631 533, email jaga@jaga.co.uk or visit www.jaga.co.uk**

Myson LST radiators are safe and slim

Myson's range of low surface temperature (LST) radiators is perfect for commercial projects where safety is key, such as schools, nurseries and nursing homes. It complies with NHS Guidance Notes 1998, so is approved for use in hospitals.

The new 420mm model is the slimmest panel LST on the market. It comes with a 10-year warranty on radiator and casing. Myson also offers a range of thermostatic radiator valve (TRV) kits for the ultimate in control.

● **Call 0845 402 3434**

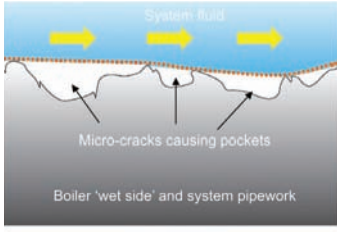
Sabien to distribute EndoTherm energy-saving heating system additive

Sabien Technology has been appointed by Endo Enterprises (UK) as the exclusive distributor in the UK for EndoTherm – a proven energy-saving heating additive for commercial multi-site heating systems. It changes the surface tension of water in a heating system, improving its thermal contact with the internal surface of heat emitters, such as radiators, air handling units and heat exchangers.

Under the agreement, Sabien will promote EndoTherm to its UK client base. It will also use its facility management partnerships and energy supplier relationships to sell and distribute EndoTherm, helping clients to reduce their energy consumption and carbon emissions, and increase efficiency in commercial heating systems.

Sabien CEO Alan O'Brien said: ' Endo Enterprises has built an impressive body of in-field verification work and was recently the recipient of CIBSE's 2016 Energy Efficiency Award. EndoTherm is proven to reduce energy consumption by between 10% and 25%.'

● **Call 0800 082 89 89, email reduceC02@sabien-tech.co.uk or visit www.sabien-tech.co.uk**



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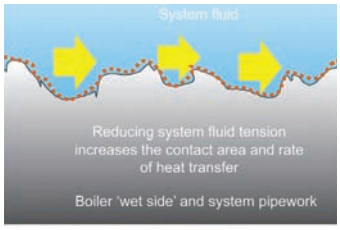


With EndoTherm

New specifications manager for Rehau in London

Vincent Ng has been appointed specifications manager at Rehau, specialising in the company's heating and cooling systems, underfloor heating, thermally activated building structures (TABS) and chilled ceiling solutions.

Ng (left) has a background working with specifiers in the civil and structural side of the construction sector, and has knowledge and experience of working alongside specifiers in the London market. He will be working with Rehau's senior commercial manager, Tony Harbour, on commercial and residential projects.

● **Call 01989 762 600, email Jo.Trotman@rehau.com or visit www.rehau.co.uk**

Oventrop solar thermal makes logistical sense

Oventrop has designed, supplied and installed four solar thermal hot water systems for industrial units at Heathrow Logistics Park.

Each system, specified by HWM Building Services, consisted of: OKF CK22 flat panel-on-roof solar thermal collectors; pre-heat storage vessels; Regusol pump station; Regtronic solar controls; Tyfocor solar fluid; and all interconnecting pipework and bracketry.

HWM and main contractor Readie Construction were pleased with the quality of the products and service that Oventrop provided.

● **Call 01256 330 441, email info@oventrop.co.uk and visit www.oventrop.co.uk**

Morgan Sindall professional service appoints new director of operations

Multidisciplinary design and engineering consultancy Morgan Sindall Professional Services (MSPS) has named Paul Smith as its new director of operations.

Smith (right) has more than 25 years' experience, and a proven track record in driving major change-management programmes and enhancing project delivery.

His role will be to support MSPS's managing director, Martin Lubieniecki, in growing the business. He will also drive a step-change within the business, giving greater responsibility and accountability to the individuals best placed to deliver customer excellence.

Smith said: 'I am genuinely excited to be afforded the opportunity to bring my operational and commercial skills to MSPS, and help Martin and the team to make a great business even better.'

Smith is a fellow of the Institution of Chemical Engineers and of the Institute of Directors, as well as being a chartered engineer and a chartered scientist.

● **Call 01789 208 252 or email clare.k.white@morgansindall.com**

Tackling fire safety in large-scale residential developments

Passive fire safety contractor Gunfire has been appointed by Leeds City Council to install fire-stopping solutions across 8,000 of the local authority's homes. It is one of the UK's largest retrospective residential fire-safety projects.

Gunfire spokesman James Reid (left) said: 'Ablative batt and mastic insulation are technologies that have been used to fill voids that could aid the spread of fire between rooms. In effect, the active intumescent ingredient chars and expands to block any fire passages.'

● **Visit www.gunite.co.uk/gunfire**

Sika's fast-curing system ensures rapid return to business of city car park

A public rooftop car park that needed new waterproofing to stop water leaking into shop retail units below, has had its need met by the Sikafloor-RB 58 system.

Benefits of the system – which comprises several layers, to guarantee a robust, watertight performance – include dynamic crack-bridging, fast curing times and high abrasion resistance.

The system also comes with a 10-year warranty and has been tested in accordance with DIN EN 1062-7.

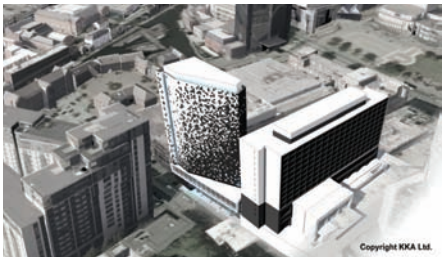
● **Call 01707 or visit www.sika.co.uk**

Nittan smoke detectors stop false alarms from vaping

Nittan's Evolution EV-DP Dual Wavelength Photoelectric smoke detectors have been installed in a Southampton pub and music venue to prevent false alarms caused by vaping.

E- cigarettes generate water vapour, which can have the same effect as steam on a smoke detector, leading to false alarms. The EV-DP measures particle size via its combined infra-red (IR) and blue LED technology – and, as steam and dust are much larger particles than smoke, the detector won't go off.

● **Visit www.nittan.co.uk**



Holiday Inn Express uses innovative hybrid air conditioning

A new 250-bedroom hotel in Birmingham has become the first in the UK to use an innovative hybrid air conditioning technology.

Mitsubishi Electric's Hybrid variable refrigerant flow (VRF) system enables the Holiday Inn Express to keep guests comfortable in a controllable, energy-efficient way.

The design for the system was put together by SISK Design and Build Contractors, who worked with building services consultancy DW Pointer.

'Hybrid VRF uses water to transfer heating and cooling around the building, removing the need for refrigerant leak detection in occupied spaces,' said Dennis Winter, of installer Dragon Air Conditioning.

Mark Foster, managing director of Centre Island, which manages the hotel, said: 'We needed reliable and effective air conditioning that is easy to use from the guest's perspective, but is more cost-effective for the hotel, as it removes the annual maintenance costs associated with a leak-detection system.

● **Visit www.hybridvrf.co.uk**

PRODUCTS & SERVICES

Telephone: 0207 880 7633 **Email:** greg.lee@redactive.co.uk

Omnie for Sutton Coldfield house UFH

The ground floor of a substantial private property in Sutton Coldfield now benefits from the installation of the Omnie ClipPlate underfloor heating (UFH) network.

More than 1,500m of the rugged, 16mm diameter polybutylene pipes were laid into the preformed upstands of the ClipPlate panels, and connected back to two custom-built, eight-port Omnie manifolds.

Omnie offers customers a comprehensive specification and design service to help ensure that the completed project achieves both the client's and consultant's objectives.

● **Call 01392 363 605, email projects@omnie.co.uk or visit www.omnie.co.uk**

SC-Contur: a German-engineered, press-connection solution

Plumbing company Viega has introduced its SC-Contur technology to the UK market. SC-Contur is a unique and effective design feature that ensures safe and reliable press connections are achieved consistently.

SC-Contur is incorporated within pressings across the Viega range, including connections for 12mm to 108mm pipe.

Connections are up to 50% faster to install compared to soldering and – without the need for hot works – it is also safer and cleaner.

● **Visit www.viega.co.uk**

Wieland makes a powerful connection at One Puddle Dock

Wieland Electric has supplied its Metalynx structured wiring system as part of the £20m refurbishment of One Puddle Dock, a six-storey commercial premises in the City of London.

The project includes the removal of existing services, partitions and floor coverings of the 100,000ft² floor space, and the refurbishment – to Cat A standard – of the sub-let space.

Other office areas will be fitted to Cat B standard, which includes M&E installations, eight new lifts, raised access flooring and new toilet cores.

● **Visit www.wieland.co.uk**

DIRECTORY

Your guide to building services suppliers

Telephone: 020 7880 7633 **Email:** greg.lee@redactive.co.uk

Air Conditioning

Air Conditioning

Air Handling

Energy Efficiency

Ventilation and Air Conditioning

Hydraulics and Fire Protection Engineers

With a range of exciting projects throughout New Zealand and the Asia-Pacific region, we are looking to increase our capability with the appointment of additional Hydraulics Engineers (also known as Public Health or Plumbing and Drainage Engineers) and Fire Protection Engineers.

Building Services at Beca

With over 200 mechanical, electrical and fire engineers throughout New Zealand and approaching 400 throughout our Asia Pacific business, Beca has the skills and experience to deliver integrated building services solutions that are sustainable, cost efficient and flexible. We work with architects, contractors, building owners and developers to innovate engineering solutions that respond to the performance needs of today's buildings.

You can find out more about these roles and other building services opportunities by visiting **www.becabuildings.com**

Support with relocation and immigration will be provided if you are joining us from overseas.

For a confidential chat call **Heather Douglas** (Associate – Talent Acquisition Partner) on **Ph +64 9 300 9136** or simply apply today!

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For further information and to apply, please call us on **+44 (0)203 176 2666** or email **cv@b-a-r.com**

Mechanical Building Services Director

East Croydon, To £125k + shares and benefits

A design consultancy that was established over 30 years ago, who focus on projects in the education, residential, healthcare, retail, and commercial sectors are looking to expand their team further. They employ over 30 staff and continue to promote within. You will oversee delivery of all mechanical building services projects, staff management, chair leadership meetings, develop new and existing business relationships, mentor staff and play a key role in the future development of the company. Ref: 4017

Senior Electrical Engineer

Oxford, To £55k + benefits

A unique opportunity for an electrical engineer with 5-8 years experience and a background within rail, specifically station design, has arisen for my renowned client based in the Oxford area. You will be instrumental in the growth of the rail division and rewarded with an excellent package and career path. Ref: 3683

Senior Mechanical Engineer

Central London, £40 p/h

Our client has an environment filled with forward thinking engineers that have the core objective to meet the needs of their clients by developing well-integrated buildings with simple systems that work with natural laws of physics. The requirement is for a Mechanical Engineer to come on board and take a lead role on a number of projects from within their expansive portfolio across a host of sectors. Ref: 3923

Electrical Engineers

London, £39 p/h

Senior to Associate level required for a long-term contract, working on prestigious projects mainly within the science, data centre, laboratory, and health care sectors. Degree qualified, chartered engineers preferred with experience on large power, UPS, generators, on complex or major projects. This position will be working within an exceptional design team on UK and global projects with key architects and high profile clients. Ref: 4016

Senior Public Health Engineer

London, To £42 p/h

An international consultancy that is at the forefront of high performance buildings with a focus on sustainable design has an opportunity for a Senior Public Health Engineer to join the well-established team in London. You will have the opportunity to work on some of the most iconic buildings on the planet and be presented with the opportunity to push the boundaries of design within the built environment. Ref: 4005

Principal / Associate Electrical Engineer

Oxford, £50 - £70k + benefits

If you are reaching the phase in your career where you wish to become part of a senior management team, take a more strategic position and have a recognised influence in the company you work for, then we have an incredible opportunity for an ambitious individual to take the reins in driving the business forward for this well-known and respected design engineering consultancy. A fantastic remuneration package and highly rewarding career are on offer for the right person. Ref: 3918

Thinking of your future

www.b-a-r.com

Events & training

NATIONAL EVENTS AND CONFERENCES

CIBSE Building Performance Awards
7 February 2017, London
The shortlist has been announced. Don't miss your chance to find out who will take home the trophies. Book your place now.
www.cibse.org/bpa

CPD TRAINING

For more information, visit **www.cibse.org/mcc** or call **020 8772 3640**

Practical HVAC controls
5 December, London

Mechanical services explained
6-8 December, Manchester

Energy building regulations: Part L
6 December, Manchester

Practical project management
7 December, London

Building services explained for FMs
7-9 December, London

Energy monitoring and targeting
9 December, London

Mechanical services explained
12-14 December, London

Practical controls for HVAC systems
13 January 2017, London

Mechanical services explained
24-26 January 2017, Birmingham

Electrical services explained
24-26 January 2017, London

Power system harmonics
26 January 2017, London

Air-conditioning and cooling systems
27 January 2017, London

ENERGY ASSESSOR TRAINING

For more information visit **www.cibse.org/events** or call **020 8772 3616**

Air conditioning inspector
6 December, London

LCC design and EPC
13-14 December, London

LCC building operations and DEC
7-9 December, London

LCC design and EPC
17-18 January 2017, London

LCC design and EPC
24-25 January 2017, Leeds

ISO 50001
31 January-2 February 2017, Bristol

CIBSE GROUPS, REGIONS AND SOCIETIES

For more information, visit **www.cibse.org/events**

HCNW and WiBSE: Work, career, inclusivity – unconscious bias
5 December, London
A joint event, with CIBSE President John Field, followed by a seminar on automatic and unconscious bias by professional trainer Helen Jamieson.

Hong Kong: BSOMES: 7th Greater Pearl River Delta Conference
6 December, Hong Kong
The annual conference, bringing together researchers and practitioners from Hong Kong, Macao and Guangzhou to share ideas, information and experiences of building operation and maintenance.

Southern: Engineer effects of dark skies
6 December, Chichester

West Midlands: Membership briefing
7 December, Birmingham
With a focus on Associate and Member grades, and registration with the Engineering Council at the Incorporated and Chartered Engineer levels.

East Midlands: YEN winter social
8 December, Leicester
Winter social with bowling, sponsored by Daikin.

Merseyside and North Wales: Actual efficiency of renewables
8 December, Liverpool
Presentation on research into renewables and low carbon energy sources by Professor Andy Shaw, director of the Built Environment and Sustainable Technologies Research Institute at Liverpool John Moores University.

North East: Technical meeting
13 December, Newcastle
Presentation by Nigel Banks of Keepmoat.

Webinar: How to start your engineering practice report
14 December
A CIBSE membership webinar designed to help you get to grips with the competence criteria for ACIBSE & MCIBSE.

Yorkshire: Student research conference
15 December, Leeds
Students will present a research paper, in part fulfilment of their final-year degree award. This year, topics include: LED lighting applications, heat pumps, daylight analysis, natural ventilation & air quality, PV solar applications and building control strategies.

South Wales: Membership briefing session
9 January 2017, Wales
The main focus will be on applications for the Associate and Member grades, and Registration with the Engineering Council at the Incorporated and Chartered Engineer levels.

North East: Technical meeting
10 January 2017, Newcastle
With speaker Andy Alpin.

East Midlands: Water regulations, Kemper and water treatment
10 January 2017, Derby

West Midlands: CPD technical seminar on TM30
11 January 2017, Birmingham
CPD seminar on TM30, with speaker Peter Raynham, from University College London.

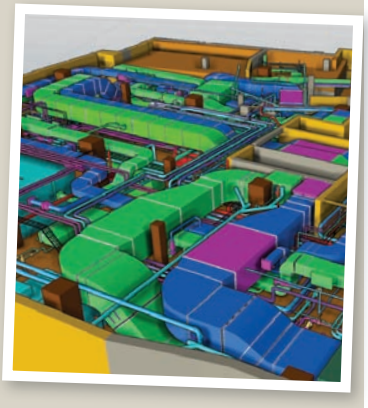
HCNW and IHEEM: Institutions and international collaboration
11 January 2017, London
With speakers Julian Amey, Institute of Healthcare Engineering and Estate Management (IHEEM) chief executive; Christopher Northey, IHEEM past president; and John Crawford, IHEEM London branch past chair.

Rep of Ireland: CIBSE membership briefing session
18 January 2017, Dublin
Presentation by Gillian Francis, of CIBSE Membership, explaining the various grades available with CIBSE and how to achieve chartership.

BIM Roadshow
18 January 2-17, Birmingham
New roadshows helping delegates to understand their knowledge and skills shortfalls, and to plan how to incorporate and implement BIM in their business.

SLL Masterclass
26 January 2017, Birmingham
Continuing the Society of Light and Lighting's knowledge series, which focuses on human responses to light.

CIBSE BIM Roadshow
January – May 2017



CIBSE is hosting a series of one-day seminars across the UK and Ireland, focusing on the practical ways that BIM can be applied by stakeholders in the construction process. The seminars will demonstrate how to work smarter using BIM, as well as how to use digital assets more effectively.

This roadshow is intended to illustrate that technologies and processes can be used to increase efficiency, accuracy and quality of information, and reduce the risk on projects, by exposing data in a structured way.

It concentrates on the real-world application of digital technologies and workflows, and will guide attendees through pre-concept to completion of an example building project.

By sharing openly – and using relatively simple technology and techniques – delegates will see how to use data from a single source to generate multiple outcomes.

The next event will take place on 18 January in Birmingham. Visit the website to see the full list of dates and venues and to book. CIBSE members receive a 30% discount.

For more information go to **www.cibse.org/BIMRoadshow**

BIM Roadshow

Delivering performance not promises

November 2016 - May 2017

Turn theory into effective practice. Discover how to correctly implement BIM throughout each stage of a building project.

CIBSE is hosting a series of one-day seminars across the UK and Ireland, focusing on the practical ways that BIM can be applied by stakeholders in the construction process.

Let our experienced BIM practitioner guide you through pre-concept to completion of an example building project.

Attend a BIM Roadshow near you to:

- Understand what the employer actually wants
- Design using single source data to eradicate errors
- Use your data more efficiently
- Exchange data with design team partners
- Have more confidence in the data

30% off for all CIBSE members

Tickets on sale now

View the full agenda, find a roadshow near you and book your place at

www.cibse.org/BIMRoadshow

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Panel Mount Pressure or Velocity Transducers with remote alarms, analogue and digital interfaces. Traceable calibration certificates supplied as standard.

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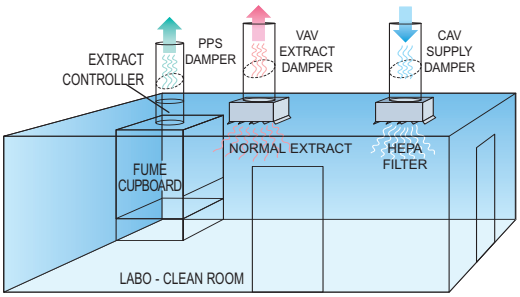

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Poly-propelene control and shut off valve incorporating the CMR Venturi Nozzle. This is essential when dealing with corrosive extract air especially from fume cupboard systems.

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