CIBSE JOURNAL

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BRADFORD UNIVERSITY'S CARBON CHAMPIONS

THE VIRTUAL REALITY OF ACOUSTIC MODELLING

AIR CONDITIONING WITH BATTERY STORAGE

A LIFE OF SERVICE

Max Fordham on his career and vision for planet Earth

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Sound and vision

The 2017 CIBSE Building Performance Awards shone a light on another raft of excellent projects, products and engineers. In particular, they highlighted the work of Max Fordham, the University of Bradford and Elementa Consulting, which all won two awards.

It is worth reading our interview with Max Fordham to understand why the practice is so revered and has sustained its success for so long.

The consultant engineer's culture is rooted in principles laid down by Fordham in 1966, when he established the firm. A strict application of scientific principles, and the willingness to question conventions is central to his philosophy. Fordham is a stickler for accurate drawings, so it's no surprise to learn he is using the Passivhaus methodology in the design of his new home (page 28).

Building services engineering has often been slow to adopt new technology that has had proven performance in other industries. With challenges around integration with existing systems, this has often been for a good reason. But, this month, we feature two examples of technology that is getting a foothold in the sector.

Battery technology is well established in the car industry, and is now set to make its mark in the commercial building arena. On page 48, we have details of a chiller, with battery storage incorporated. The power-management system controls the power inputs from the mains electrical supply and renewable sources, such as PVs and wind turbines. It enables the system to harness the cheapest – or lowest-carbon – energy source to power the chiller, with the battery pack providing the buffer. The chiller can then be recharged at night, when electricity is at its cheapest. It also has the benefit of an uninterruptible power supply as standard, rather than an expensive add-on.

In our feature on page 46, we learn how one consultant has incorporated an Oculus Rift virtual reality headset into its acoustic modelling, allowing users to listen how sounds change as they visually move around a three-dimensional space. It could mark the end of sitting in lecture theatres straining to hear the speaker, as consultants can use the system to test different acoustic finishes while the virtual lecturer talks from the stage.

Our acoustics special also includes an article by an engineer, who claims that external noise is often not factored in when ventilation strategies for city homes are designed (page 45). The result? Windows remain closed and dwellings overheat. It's another reminder of the value of integrated design.

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Hywel Davies
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IN BRIEF

Tall buildings market hits the heights

More high-rise buildings are now being constructed in the UK than at any other time, according to a new report from AMA Research.

Around 500 buildings are in the planning pipeline – more than 85% of them in London – and about 70% are primarily residential. However, the proportion of mixed-use schemes is predicted to grow, according to the *Construction in the High-Rise Buildings Market Report: UK 2016-2020 Analysis*. 'In London, the market is being driven by the buoyant private housing sector, especially at the top-end of the market, and the resurgence in demand for commercial property,' the report states.

'However,' said Hayley Thornley, research manager at AMA, 'there are concerns about too many projects aimed at the luxury end of the market, a focus not matched by housing demand. In addition, the uncertainties surrounding the EU referendum may influence some schemes, with many projects in the pipeline forecast to exceed stated completion dates.'

DOUBLE WINS FOR TWO CONSULTANTS AND BRADFORD UNIVERSITY

There were three double winners at the CIBSE Building Performance Awards last month. Max Fordham was consultant on Keynsham Civic Centre (above), which won Project of the Year: Public Use. It was also named Building Performance Consultancy of the Year (101-1000 employees). The overall Carbon Champion was the University of Bradford's department of estate and facilities, which also won the Facilities Management Team Award. Read about the founder of Max Fordham on page 28 and Bradford on page 32. Elementa scooped Project of the Year: International and also Building Performance Consultancy of the Year (up to 100 employees).

Brexit will 'change nothing' about EU regulations

The building services industry should assume that European regulations that currently affect the UK will still be in force immediately after Britain leaves the European Union (EU) in 2019, says CIBSE technical director Hywel Davies.

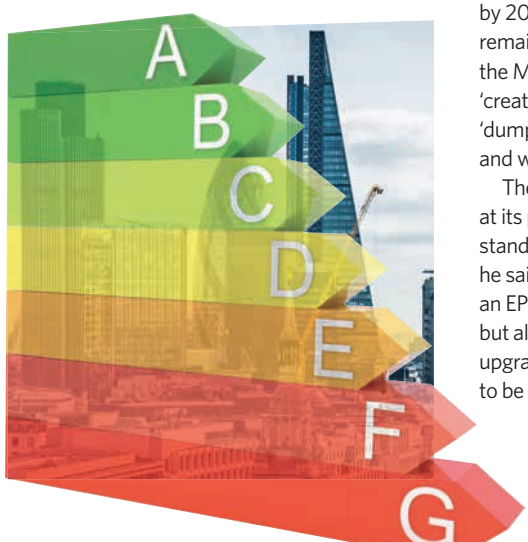
In his annual legislation briefing to the CIBSE Patrons last month, Davies said the government's Brexit White Paper, which paves the way for its Great Repeal Bill, clearly states that UK law on the day we leave the EU 'would still be UK law the day after'.

'Leaving the EU will change nothing immediately – at least in terms of legislation that affects our industry,' said Davies, who supplied a list of regulations that would initially remain in force, including: Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs); minimum energy efficiency standards; the F-Gas Regulation; the Energy-related Products (ErP); Building Regulations; and the Climate Change Act.

'Several are a mixture of UK and EU law, which would be extremely tricky and counterproductive to unpick. The government has recognised this and provided welcome clarity on the way forward,' Davies added.

He pointed out that the government had also committed to carbon-reduction targets beyond 2032 and that the UK Climate Change Act remains in force, with the aim of a 57% reduction in emissions by 2030. 'Dismantling policies that are already contributing to these reductions would be illogical,' said Davies. 'And scrapping things because they are European would just create unnecessary work.'

He said the government is actually under pressure to come up with further carbon-reduction measures, as the Committee for Climate Change had identified a gap of 100 million tonnes of CO_2 equivalent that needs to be tackled to meet long-term goals.



Davies said he expected the planned revision of Part L of the Building Regulations – designed to ensure its measures remain 'cost optimal' – to go ahead. 'However, there is no sign of any engagement with the industry yet,' he added.

Targets for 'nearly zero energy new buildings' by 2021 (2019 for some public buildings) remain in place, but work needs to be done on the Metering and Billing Regulations. These had 'created mayhem', says Davies, as they were 'dumped on the industry without consultation' and without being thought through.

The government may also has to look again at its plans for minimum energy efficiency standards, due to come into force next year, he said. 'Some landlords appear not to have an EPC, and this only carries a small penalty, but allows them to avoid the requirement to upgrade their buildings. This loophole will have to be closed if the standards are to be effective.'

IN BRIEF

Guidance launched for Minimum Energy Efficiency Standards

The government has published guidance on the Minimum Energy Efficiency Standards due to come into force for privately rented commercial buildings in April 2018.

Under the Energy Efficiency Regulations, it will be unlawful for landlords to grant a new lease for properties that have an energy performance certificate rating below E.

This guidance outlines the steps landlords will need to take to ensure their property complies, and is also intended to be read by enforcement authorities.

CIBSE technical director Hywel Davies said: 'It is important that this guidance has been issued more than a year before the new regulations come into force, to allow owners to understand what they must do to prepare.'

IoR past president says HFC phase-down will be speeded up

Star Refrigeration's Andy Pearson predicts faster removal of refrigerant

Reducing the use of HFC refrigerant gases in commercial air conditioning systems is likely to be accelerated, according to a former President of the Institute of Refrigeration (IoR).

Andy Pearson told last month's online meeting of the CIBSE ASHRAE Group that the signing of the Kigali Accord last year linked refrigerant phase down to the Montreal Protocol, meaning it will probably happen more quickly than currently foreseen. He cited the example of CFCs – also managed under the Montreal Protocol – which moved quickly from an original target of 50% reduction to total ban.

'The dates can be changed quite easily,' said Pearson, who is group managing director of Star Refrigeration. 'This acceleration also happened with HCFCs and I expect the same will happen with HFCs – their removal will happen more quickly than the current timetable suggests.'

The F-Gas Regulation is on course to reduce HFCs to 21% of their baseline level, but Kigali is set to lower that to 15%. It requires developed economies to start removing HFCs from 2019. Developing countries will start to restrict use in 2024 and begin reductions in 2029.

Pearson told the CIBSE ASHRAE Group there was unlikely to be a phase down of any other refrigerant once HFCs are gone, but 'there may be more changes… as a result of flammability and toxicity concerns about some of the replacements' (see below). His full presentation can be viewed at: **www.cibseashrae.org**

Future air con refrigerants may have to be flammable

The refrigerant gases used in many air conditioning systems in the future will be flammable, according to research carried out by the US National Institute of Standards and Technology (NIST).

Researchers looked at 60 million chemicals to find a replacement for the widely used R410A – which is due to be phased down because of its global warming potential (GWP) – and found only 27 'suitably efficient' fluids, all of which were at least slightly flammable.

The NIST team said it was 'disappointed and surprised' that it failed to find a refrigerant that combined low GWP with other desirable performance and safety features, particularly as flammability is not allowed under current US safety codes. 'It is highly unlikely that any better-performing fluids will be found, and unknown risks associated with the lesser-known fluids may further reduce the list,' the researchers said.

'There is no perfect, easy replacement for current refrigerants,' said NIST chemical engineer Mark McLinden. 'We thought there has to be something else. Turns out, not so much.'

The Kigali Accord, signed last year, has agreed a programme to phase out the use of HFC gases under the Montreal Protocol. This, plus the European F-gas Regulation, will result in high-GWP refrigerants being removed from many applications. These include refrigerants such as R404A and R134a, where suitable alternatives are already in place.

R410A – a blend of R32 and R125, and the most common refrigerant used in small air conditioning systems – has a relatively high GWP of around 2,000. This is 50% higher than R134a and most experts believe it will have to be replaced. R32 is used in some small, split systems and propane is also being considered in similar applications by some Far East markets, but their flammability means they are outlawed from all but the smallest systems under current international safety standards.

UK on its final warning over air pollution levels

Country must demonstrate how it intends to tackle NO_2 in 16 areas

The UK faces prosecution in the European Court of Justice later this year for failing to comply with European Union (EU) air-quality regulations. It has been issued with a final warning by the European Commission and has less than two months to show how it intends to tackle rising levels of nitrogen dioxide (NO_2) in 16 areas, including London, Glasgow, Birmingham and Leeds.

It is estimated that 40,000 Britons die prematurely each year from respiratory, cardiovascular and other illnesses associated with air pollution, and the annual cost to the NHS is put at £20bn, with six million working days lost.

Germany, Italy, France and Spain have also been served with final warnings with 23 out of the 28 member states – and 130 European cities – struggling to meet EU pollution limits.

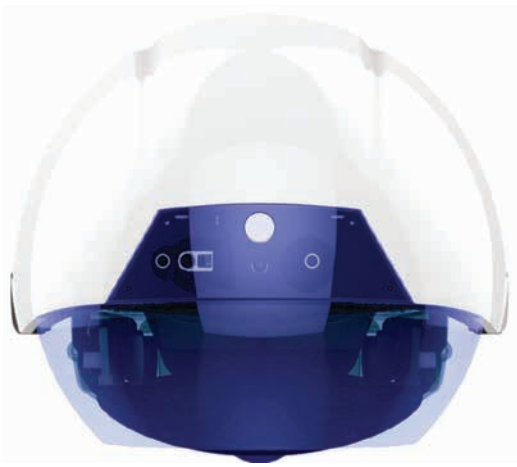
A coalition – including Greenpeace, Friends of the Earth, the Royal College of Physicians, the British Lung Foundation and environmental lawyers ClientEarth – has called for a new Clean Air Act, 60 years after the original legislation created by Winston Churchill's government. British Lung Foundation chief executive Dr Penny Woods said air pollution was now a 'public health crisis'. 'We need a new, fair and ambitious Clean Air Act, with targets to slash pollution levels across the country.'

The Building Engineering Services Association (Besa) has called for the proposed act to ensure buildings can become 'safe havens'. 'Reducing toxic emissions from vehicles and industrial processes is vital, but will take many years to produce results,' said chief executive Paul McLaughlin. 'Improving building ventilation is a quick and relatively painless process that can help protect people in the meantime.'

Illnesses related to air pollution cost the NHS £20bn a year

SKANSKA LOOKS TO THE FUTURE WITH AUGMENTED REALITY

Skanska is to trial augmented reality (AR) smart helmets on its sites in the UK. The DAQRI wearable technology gives users instant information, overlaid on their line of sight. Among the data that could be relayed to users are technical and 3D drawings, and real-time information from sensors. DAQRI also has thermal-imaging capability, and allows experts to connect to the helmet remotely and see issues through the eyes of the user.



EU countries slack over smart-building policies

European countries are failing to develop policies that encourage the growth of smart building markets, so are missing out on the opportunities presented by energy storage and demand-response technologies, claims the Buildings Performance Institute Europe (BPIE).

The UK was labelled a 'follower' rather than a 'leader' in smart building initiatives in the think-tank's report, which also said current EU legislation was failing to foster 'innovative and intelligent smart city upgrades'.

Only the rollout of smart meters had been widely adopted across member states – and, even then, only Sweden, Finland and Italy had completed their nationwide programmes.

The Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED) were criticised by the BPIE for failing to remove barriers to market growth.

Public buildings need urgent quality checks

The Royal Incorporation of Architects in Scotland (RIAS) has said public bodies should review the build quality of their recently commissioned properties after an enquiry into a collapsed wall that led to the closure of 17 schools in Edinburgh. The Cole report into the accident – at Oxgangs Primary School in January 2016 – picked out the main contractors' quality-assurance processes and the standard of bricklaying for particular criticism.

'When major inquiry reports are published, there is a tendency for everyone to breathe a sigh of relief and move on,' said RIAS president Willie Watt. 'That should not be the case with this extremely well-researched and deeply concerning report.'

He added that the message was 'simple and the responsibility of all commissioning authorities was clear. It was fortunate that nobody had been injured, or killed,' said Watt.

Clients 'not ready' for smart technology

More than 60% of building clients have no plans to install connected technology in their buildings and 40% say they are unfamiliar with terms such as the Internet of Things, according to a survey by CIBSE, the Electrical Contractors' Association and Scottish electrical trade body SELECT.

More than half of the respondents – who included consultants, engineers, end clients, local authorities and facilities managers – said a lack of 'clear advice/knowledge' was a barrier to installing connected technology.

However, the survey also showed that clients expect buildings to experience a smart technology revolution in the next five years. The technologies most likely to be installed over this period were: CCTV and security (78%), heating (74%), fire systems (69%) and BEMS (67%).

Designers must tackle rising threat of hot homes

New academic papers reveal extent of overheating in homes

A perfect storm of technical, economic, and cultural factors is causing alarming levels of overheating in homes, according to speakers at a recent Edge debate.

Professor Kevin Lomas FCIBSE, from Loughborough University, said the rise in overheating has been caused partly by the move towards airtight, insulated homes.

He said other factors included: urbanisation; climate change; cost-cutting; an ageing population; and cultural factors that mean people are failing to understand how to avoid overheating. 'Construction firms aren't very good at designing to avoid overheating and SAP doesn't do a tremendously good job,' Lomas added.

In the debate *Overheating in UK buildings – a disaster waiting to happen?*, Professor Rajat Gupta, of Oxford Brookes University, reported on overheating in care homes. He found a lack of heat management and a low prioritisation of climate change in briefing and design. He said: 'There is a need to monitor indoor and outdoor temperature in care settings, and feed back to management, care staff and residents.'

Overheating is a low priorty in care homes

Professor Fionn Stevenson, of the University of Sheffield, revealed that residents in a recent 1960s retrofit were overheating because of poor design and guidance. She found that only 9% used the mechanical extract ventilation continuously, and many were wedging front doors open to keep cool. She said: 'Inhabitants are really good at learning together, if you give them the chance to adapt, but designers have to give them the opportunities.' Residents learned socially by disseminating information on overheating across a residents' Facebook group, she added.

The talks are based on papers in a *Building Research and Information Journal* special issue. More at **bit.ly/2lz08Hc**

Contractors owed more than £1bn under archaic retentions system

The UK's top 12 construction companies are owed more than £1bn in payments withheld by clients in the form of 'retentions', according to the Specialist Engineering Contractors' (SEC) Group, which analysed their accounts. It added that this has a catastrophic knock-on effect on their supply chains.

'More than 80% of this sum would have comprised the retentions withheld by these companies from their supply chains, the overwhelming majority of which would be SMEs [small and medium-sized enterprises],' a SEC Group statement said. Chief executive Rudi Klein said there was no other UK industry sector in which such a large amount of cash was at risk, especially for SMEs. 'In a high proportion of cases, the retention represents the profit element for SMEs.'

Klein said the 200-year-old system of cash retentions in the construction industry exists 'ostensibly as security, in case a firm does not return to rectify defects' – but that 'in practice, retentions are used to bolster the cashflow of the party holding them'.

SEC Group estimated that £0.4bn was being withheld by public sector bodies, and Klein claimed that many used retention money to finance other work – or, in some cases, invest it 'on the overnight money markets'. He called for legislation to ring-fence retention money, pointing out that small firms lost between £40m and £50m in 2015, as a result of insolvencies further up the supply chain. 'Cash retentions are deducted from due payments, so legally belong to the companies that have carried out the work,' added Klein.' Thousands of SMEs wait several years to recover their outstanding retentions.'

CIBSE to launch new overheating guide

A detailed process for assessing overheating in homes during the design stage will be launched by CIBSE in April. *Methodology for the assessment of overheating in homes using dynamic thermal simulation* – a technical memorandum (TM) by a team from CIBSE, Arup, Inkling and Aecom – is to be used with dynamic simulation software.

It was written because of the Greater London Authority's requirement to carry out in-depth thermal analysis of all new developments, using criteria in TM52 *The limits of thermal comfort: avoiding overheating in European buildings* and TM49 *Design Summer Years for London*. However, the requirement left a lot of room for misinterpretation, said Dr Anastasia Mylona, CIBSE research manager. 'We put our experience together to come up with a robust process for describing overheating criteria, occupancy profiles, internal gains, window description and operation,' she added.

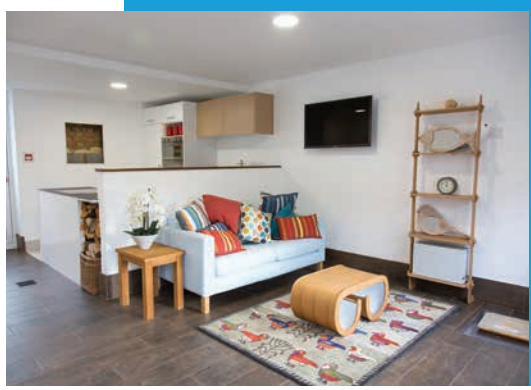
The methodology has been tested by 14 consultancies in live projects, and will be made available to bidders for the Department for Communities and Local Government's overheating research project.

Flood-resilient home unveiled

BRE has launched a flood-resilient prototype property to show the most effective ways to protect homes against flood damage. The solutions include: flood-resistant doors and windows; water-resilient walls and insulation; moveable kitchen units; floor and wall membranes that channel water towards drains; automatic sump pump that stops water rising through the floor and disperses it quickly; and one-way valves on toilets and sinks to prevent flooding via sewers.

Different types of water-resilient insulation have been used, including injected cavity wall insulation, thermal board and polyurethane spray foam. Other practical issues addressed include improving floor insulation, electric sockets and home-appliance location.

The prototype is at BRE's Garston site



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IN BRIEF

Competition entries get the green light

Entries are open for the 2017 Society of Light and Lighting (SLL) Young Lighter of the Year Competition, which is now in its 23rd year.

The contest offers a unique platform to young lighters and is open to all. It allows young lighters to present their knowledge and research on a lighting subject, hone their presentation skills, and raise their profile within the industry.

Shortlisted finalists will give a 15-minute presentation to a LuxLive audience in November 2017, and all finalists will receive a cash prize, plus a year's free membership of SLL.

Watch the 2016 shortlisted video presentations – and read last year's winning paper, *Variable lighting levels for highways*, by Sofia Tolia –at **www.cibse.org/sll**

Entrants should be aged 30 or under on the closing date of 8 May. Enter now at **bit.ly/2lxYZPO**

Applications invited for lighting bursary

Applications are now open for the 2017 Jean Heap Bursary, which awards up to £4,000 in funding for lighting projects.

The bursary was launched in 2014 as a tribute to the commitment Heap showed to lighting research and education within the Society of Light and Lighting (SLL) throughout her career.

The competition is open to everyone with an interest in lighting, and the judging panel will be looking for a piece of study or research designed to benefit the industry and SLL.

Applicants should outline their proposed research project, including: the specific topic to be researched; the methodology and timescale; and the aims and objectives of the study.

Proposals should also include an outline of why the applicant needs further funding and how the additional funds will be used in the research.

For more information and to apply visit **bit.ly/1qll05P**
The successful applicant will be announced at the SLL AGM in May.

Seminar series offers smart advice on energy metering

Smart metering is taking centre stage Down Under

Seminars to address essential elements of metering system design

The CIBSE Australia and New Zealand (ANZ) Region is hosting a series of four seminars on metering, with the key message 'you can't manage what you can't measure'.

The seminars will address all the essential elements of metering system design, installation, commissioning and maintenance for building services engineers, contractors and building owners and managers, including electrical, thermal and flow meters. Keynote speaker Hywel Davies, CIBSE technical director, will launch the new edition of TM39 on 'Building energy metering' in Australia and New Zealand.

Other speakers include:

- David Palin, from Mirvac, Chris Nunn, from AMP, and Bruce Precious, from EPT, who will cover the requirements of – and their experiences with – metering, from both an owner's and developer's point of view
- Representatives of the green building councils of Australia (GBCA) and New Zealand (GBCNZ), and of Nabers, who will talk about their requirements for metering for energy-rating tools
- Paul Dearlove and Matt Holmes, from IBMS, who will speak about their experiences of supplying, installing and commissioning meters.

The seminar dates are:

- 14 March – Perth, WA
- 16 March – Melbourne, Victoria
- 21 March – Auckland, New Zealand
- 23 March – Sydney, NSW

Davies will also be presenting short technical talks on metering in Adelaide, SA, on 15 March and Brisbane, Queensland, on 22 March.

For details, registration and sponsorship opportunities, visit **www.cibse.org/anz**

EcoBuild launch for 2017 green infrastructure design challenge

CIBSE, in partnership with the ARCC network, will coordinate the 2017 design challenge on the use of green infrastructure as a building service.

The challenge will be looking for designs that demonstrate how indoor and outdoor green infrastructure can contribute to the health, wellbeing and productivity of staff, while simultaneously improving the building's energy efficiency and climatic resilience.

The interaction of indoor plants with heating, cooling, acoustic management, air quality, staff productivity and wellbeing is an exciting and growing area of research; benefits of green infrastructure don't need to remain outside the building entrance.

This design challenge will be launched at London venue EcoBuild – which is being held at ExCeL from 7-9 March – and is open to individuals or teams, students, practitioners, and researchers.

The deadline for submission of entries is 8 May, and the winning designs will be exhibited during Green Sky Thinking Week, from 15 to 19 May.

For more information about last year's challenge, visit **bit.ly/2l0HvgX**

Challenge to show benefits of green infrastructure

Members of the CIBSE Building Simulation Group with runner-up Richard Hendry (centre). Left to right: Darren Woolf, Hazim Awbi, Darren Coppins and Naghman Khan (also secretary of IES, the award sponsor)

Tropical heat stress puts Chowdhury in first place

Bangladesh-based engineer scoops student prize worth £8,000

A report on *Indoor heat stress evaluation for factories in the tropics* has won the 2016 Building Simulation Group Student Prize, sponsored by Integrated Environmental Solutions (IES). Author Sajal Chowdhury, who studied at Hokkaido University, Japan, based his entry on his MEng thesis.

Chowdhury's research was commended for its detailed modelling approach, delivering relevant information and recommendations for achieving comfortable work environments in factories under tropical weather conditions.

He won £1,000, plus a 12-month licence for the IES VE-Pro software suite and a place on an IES training course, worth more than £7,000. Chowdhury is now a faculty member at the Bangladesh University of Engineering and Technology.

The two highly commended runners-up, who each took home £250, were Connor Shaw and Richard Hendry. Shaw studied for a MSc in construction and real-estate management at the University of Applied Science in Berlin, Germany, with a project entitled *Towards automated building energy performance simulation for BIM-based renovation projects*. He founded Shaw Architectural Solutions in 2014.

Sajal Chowdhury

Hendry, who works at Troup Bywaters + Anders, studied for an MSc in building services engineering at London Southbank University, and his dissertation is *Applying building energy modelling tools to operational energy use*.

For more information about the award, visit **www.cibse.org/bsg**

Grab yourself a chance to travel

The Ken Dale Travel Bursary offers between £1,500 and £4,000 to CIBSE members in the developmental stage of their career, who wish to spend three to four weeks abroad researching aspects connected to their field of work.

Now open for entries, the bursary offers young building services engineers the opportunity to experience technical, economic, environmental, social and political conditions in another country, and to examine how these factors impact on the practice of building services engineering.

Last year's winner, Elie El Choufani, travelled to Hong Kong, Stavanger, Bergen, Oslo, the Galapagos Islands and San Francisco investigating energy reduction in airports.

He said at the time: 'Winning the CIBSE Ken Dale Travel Bursary is an aspiration for most young engineers in the building services industry. To me, it means gaining new perspective. By leaving my comfort zone, visiting new countries and experiencing different conditions in new cultures, I get the opportunity to push my learning boundaries in one of the most creative ways.'

CIBSE is especially keen to encourage applicants to take up the award for research topics that articulate the institute's concern for the environment.

The closing date is Friday 14 April. For details and to enter, visit **www.cibse.org/awards**

Have your say on plans for HVAC SIG

A proposal to establish a Special Interest Group (SIG) for HVAC systems has been submitted to CIBSE Technology Committee. The group would enable specialists to share ideas and knowledge on the design, installation and operation of heating, ventilation and air conditioning.

There is still much we do not know about the operation and performance of HVAC systems. The SIG would offer engineers a chance to share and promote best practice and help deliver better performance for building users and other stakeholders.

CIBSE membership embraces a wide range of specialisms that extend beyond HVAC engineering. The proposed group will allow other relevant SIGs – such as Energy Performance, Facilities Management, Natural Ventilation, Intelligent Buildings, Controls and Schools – to complement, support and strengthen the work they do.

For more about the proposed HVAC SIG, visit the Networks section of the CIBSE website. Members can support or comment on the proposal by emailing **groups@cibse.org** by Monday 20 March.

Podcast update

The latest CIBSE **#Build2Perform** podcast features an interview with Ant Wilson MBE (below), director of sustainability and advanced design at Aecom, reflecting on his career and aspirations following his recent honour.

Hosted by Matt Snowden, CIBSE PR and communications executive, the monthly podcast looks at different aspects of building performance and explores what is happening to make buildings more sustainable.

Download the podcast at **www.cibseblog.co.uk** or search **#Build2Perform** in iTunes. You can also read blogs about the CIBSE Building Performance Awards, and get a preview of the Technical Symposium 2017 highlights.

Ant Wilson

New members, fellows and associates

FELLOWS

Abela, Alan
Newport Pagnell, UK

Au, Tat Kay,
NT, Hong Kong

Beadle, Graham Patrick
Enfield, UK

Bourne, James
Colchester, UK

Chan, Kwok Yu Alex
Shatin, Hong Kong

Duffy, Sharon Therese
Epping, UK

Dulange, Kailas Channappa
Bangalore, India

Eastland, David James
Sutton, UK

Fung, Hop Keung
Shatin, Hong Kong

Ma, Wing Hon
Kowloon, Hong Kong

Parker, Richard Andrew
Leeds, UK

Pilbeam, Francis Wilfred
Bedford, UK

Walker, Ian
Shaftesbury, UK

Walker, Mark Richard
Lancaster, UK

Wong, Siu Wing Matthew
Quarry Bay, Hong Kong

MEMBER

Aird, Robert Christopher
DIFC, UAE

Aird, Jonathan
Leeds, UK

Anderson, Neil
London, UK

Bateman, Paul Andrew
Newcastle upon Tyne, UK

Beadsmore, David
Alcester, UK

Belton, John
Wadhurst, UK

Belton, Thomas
London, UK

Beniston, Sean Lyall
Reading, UK

Brooks, Bonnie
Exeter, UK

Brown, Derek Anthony
Carshalton, UK

Caria, Roberto
London, UK

Carruthers, Jon Josef
London, UK

Caswell, Farah
London, UK

Chang, Yik Lim
Tuen Mun, Hong Kong

Cheng, Ka Lun
Tuen Mun, Hong Kong

Cheung, Chi Hang
Cheung Chau, Hong Kong

Chmura, Witold Emil
London, UK

Choi, Raymond Che Wah
London, UK

Clarke, Conor
Baldoyle, Ireland

Clarkson, Lee
Scunthorpe, UK

Cleaver, Jonathan
London, UK

Dai, Longmei
Sutton, UK

Debrah, Godfried
London, UK

Derosa, Nicola
Rome, Italy

Dimacali, Joselle-Bianca
Makati City, Philippines

Do, Viet Tuan
London, UK

Dobson, Joe
London, UK

Duckett, Raymond Paul
Ferndown, UK

Eappen, Rony
Croydon, UK

Ferguson, Claire Lisa
Edinburgh, UK

Ferlito, Alfio
London, UK

Finney, John Richard
Chatham, UK

Flint, Anthony Mark
Menai Bridge, UK

Fong, Kin Yip
North Point, Hong Kong

Garbossa, Giovanni
Edinburgh, UK

Grimaldi, Oliver
St Albans, UK

Hallett, Stuart
Newcastle upon Tyne, UK

Hanna, Maged
London, UK

He, Bin
Caterham, UK

Hemmings, Ashley
Birmingham, UK

Ho, Lai Chung
Kowloon, Hong Kong

Hogan, David Allan
Horndean, UK

Holtkoetter, Mona
Dublin, Ireland

Hopkins, Samuel
Leeds, UK

Ibrahim, Hadi
London, UK

Jones, Theodore Jules
Norwich, UK

Kearney, Stephen
London, UK

Kincaid, Richard
Cambridge, UK

King, Suzanne
Birmingham, UK

Klintfalt, Mathew
St Leonards, Australia

Lane, Simon
Eastleigh, UK

Lee, Adrian
Aylesford, UK

Leung, Nai Ho
Kowloon, Hong Kong

Lewis, Matthew James
Bournemouth, UK

Liang, HongLiang
Salisbury, UK

Livesey, Andrew
Newcastle upon Tyne, UK

Lo, Sze Yui
Kowloon, Hong Kong

Logan, Alexandra
Gillingham, UK

Mak, Kai Lun
Kowloon, Hong Kong

Mak, Man Kin
Kowloon, Hong Kong

Mallakin, Erfan
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Ilkley, UK

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Amman, Jordan

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Wanchai, Hong Kong

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O'Mahony, Peter
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Painter, Birgit
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Patel, Ashraf
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Patsas, Apostolos
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Xue, Junwei
NT, Hong Kong

Yau, Wai Hung Ricky
NT, Hong Kong

Yau, Ying Man
Wanchai, Hong Kong

Yu, Hung Bun
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Glasgow, UK

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FEEDBACK

Spielvogel: 'Temperature control is the key to low heating bills in places of worship'

This month: church heating is called into question; the benefits of HIU test standards; and why heat metering is here to stay

Gospel teaching

In response to James Sheehan's article 'Tidings of comfort and joy' (*CIBSE Journal*, December 2016) places of worship, on average, use relatively little energy per unit of floor area. Every three years, the US Department of Energy publishes a Commercial Building Energy Consumption Survey, which includes houses of worship. The only buildings that use less energy per square foot are in the 'vacant' category.

In our first-hand studies of thousands of American congregations and their buildings, we conclude that temperature control – using a thermostat with intelligent recovery – is the key to low heating bills. To determine how low the temperature should be during unoccupied periods, we measured the temperature and relative humidity in a 1929-built church for 13 months. In the spring, summer and autumn, the church had a natural temperature range of 15°C. So, if a congregation was comfortable at 22.2°C, the unoccupied temperature could be as low as 7.2°C. The resulting higher relative humidity at lower temperatures preserves the building and its contents.

We have measured the energy use and characteristics of thousands of American congregation buildings over the past 36 years. With these parameters, we maintain a database that eliminates the need for computer modelling.

Another parameter we record is the fuel input capacity of the boilers and furnaces. We divide the BTUh input by the floor area of heated space. The example provided by Sheehan in his article models a 200kW boiler that is heating 728m^2 (7,836ft^2). At 80% combustion efficiency, fuel input to the boiler would be about 250kW, or about 853MBTUh. That would amount to 109BTU per square foot of heated floor area – much higher than the average in our database.

We compared fuel input per square foot to heating energy used per square foot per year in our colder climate, and published our data in the *ASHRAE Journal* and *Construction Specifier*, from which we updated this table:

Fuel input capacity in BTU/SF	Number of buildings	Burner fuel BTU/SF/Yr	Electric full load hours	Hours use of demand
0 to 45	35	43,969	1,112	144
46 to 60	51	49,236	902	142
61 to 75	37	53,177	706	158
76 to 90	48	59,993	552	156
91 to 115	54	61,552	484	141
Over 115	44	68,082	455	134
Average		**56,584**	**703**	**146**

The 'hours use of demand' is the annual average of the sum of each month's kWh, divided by that month's peak kW demand. This gives some indication of the average monthly hours for which the facility is used. Note that these buildings have approximately the same monthly hours use of demand, so the variations in BTU/SF/Yr in the above table are not related to varied hours use of the buildings. This means a boiler sized at 109BTU per square foot – like Sheehan's example – would, on average, use about 25% or more heating energy per unit of floor area than one with half its fuel input. By turning off and isolating one of two boilers, we have seen reductions in annual fuel use of up to 30%.

Larry Spielvogel FCIBSE FASHRAE

Testing, testing

In reference to 'Heat networks: change by degree' (*CIBSE Journal*, January 2017), the UK district energy market is growing, with 205,000 connections in 2014, up 16% on 2010, helped by 86 new heat networks.

A heat interface unit (HIU) is an essential element in the efficient delivery of heating and hot water to consumers on heat networks. It offers safe connection of the consumer's space heating and hot water systems to the network, as well as control and metering.

In December 2016, Besa published *UK HIU test regime technical specification* – developed with the support of DECC (now BEIS) – based on a methodology developed in Sweden for the Scandinavian market and adapted for the UK climate. The methodology aims to provide a common dynamic test platform for HIUs sold and installed in the UK.

Besa also plans to create a database of HIU performance. Products listed on this will need to be tested in accordance with the Besa method by an approved laboratory. Bsria is in the process of achieving this status, while continuing to offer testing services in accordance with its own technical standard, BTS 2/2015 *Test method for heat interface units*. Its method was developed in collaboration with key industry stakeholders and published in December 2015.

The objective of Besa's test method is to determine how an HIU interacts with the heat network of a building for low temperature hot water (LTHW) and domestic hot water (DHW) applications. It uses a calculation method called volume weighted average return temperature (VWART). Dynamic testing requires the DHW flow rate to be set at

0.06 l/s, 0.10 l/s and 0.13 l/s. Steady tests are included in the methodology, specifically for the LTHW applications at set temperatures and adjusted water flow rates, to deliver a thermal output at 1kW, 2kW and 4kW, in-line with the domestic heating and hot water profiles of the UK.

The Besa test also measures the HIU standby heat losses, the speed of the DHW delivery and checks that no unsafe DHW temperatures are delivered.

Bsria has been testing stand-alone liquid-to-liquid plate heat exchangers (PHXs) and HIUs for several years for applications including DHW, LTHW and chilled water (CHW). The test method within BTS 2/2015 assesses the thermal duty of the HIU at steady-state conditions using design flow rates and specified temperatures. Pressure drop tests and plate deflection tests are included. Bsria is currently updating BTS 2 to provide for CHW HIUs.

Both the Besa and Bsria methods cover a range of parameters associated with HIU technology, offering significantly more detail for the designer, installer and occupant. Alongside testing HIUs to determine their efficiency when related to the heat network, there is a need to establish whether manufacturers' quoted design thermal duty of HIUs and PHX units is achievable.

Colin Judd, Bsria senior test engineer

Here to stay

Terence Rook's criticisms of the Heat Network (Metering & Billing) Regulations 2014 ('Feedback: Taking the heat', *CIBSE Journal*, February 2017) are misguided and ill-informed. Unlike the Code for Sustainable Homes and Green Deal, these regulations have a more defined and practical purpose, and were primarily introduced to ensure commercial and domestic heat users are billed fairly and transparently for the heat they use.

I find Rook's assertion that 'office-block occupiers don't try to save on their electricity charges, let alone chilled water' wide of the mark. It begs the question – if certain occupiers don't care about their heating costs, why should those who do be penalised into subsidising others? Heat meters do not force users to reduce their consumption, but enable them to contribute fairly, and reduce their cost and environmental impact – if they choose to.

Contrary to Rook's arbitrary statement that heat meters are expensive, Measuring Instruments Directive-compliant ones can be installed for less than £200, and this cost can be spread over several years if need be. By insourcing heat billing, the figure of £70 per tenant per year can easily be achieved by using low-cost software and choosing an appropriate billing strategy.

Far from being consigned to the dustbin, heat metering is here to stay, given the government's wish to expand low-carbon district energy in the UK.

Bob Hatton ACIBSE, business development director, Sycous

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or write to: Alex Smith, editor, *CIBSE Journal*, CPL, 1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PB, UK. We reserve the right to edit all letters.

HAIL CAESARS

The ASHRAE Winter Conference was as big and brash as its Las Vegas venue, with more than 3,500 attendees and 350 presentations at Caesars Palace hotel. **Tim Dwyer** reports

Las Vegas is no longer just a destination for gamblers and pleasure-seekers. The huge scale of its hotels also makes it a popular venue for conferences, including the 2017 ASHRAE Winter Conference, which attracted 68,000 visitors to the expo and 3,500 conference attendees.

The Strip is an unlikely meeting place for a society with a mission to 'promote a sustainable world'. Las Vegas's misreported claim that it 'runs completely on renewable energy' is still some way from realisation. The newly opened 100MW solar array at nearby Boulder powers the city authority – so that is justified in claiming 100% renewable electricity – but, sadly, this pales when compared with the gigawatts needed by the city's hotels and businesses, which rely on natural-gas-powered electric generation.

ASHRAE President Tim Wentz presents Andy Pearson, of Star Refrigeration, with a Comfort Cooling Award for Project Excellence

ASHRAE chief executive Jeff Littleton revealed that the society has the largest annual operational budget in history – amounting to $31m. He also outlined a series of initiatives outside the Americas, aimed at extending and consolidating the influence of ASHRAE overseas. Littleton said 'one of the more important developments' is the recently signed Strategic Partnership Agreement with CIBSE, which 'builds on an existing strong relationship, strengthens it, and ushers in a new era for both organisations by greatly magnifying the ability to serve their members and the public worldwide.'

The conference technical programme took place in the labyrinthine Caesars Palace and included 350 presentations delivered by 300 speakers. The best-attended session was *Blue is the new green: The water-energy 'nexus'*, which considered the policies and history that have led to the current status quo between energy and water use in buildings. Engineer Calina Ferraro, of Randall Lamb in San Diego, illustrated the benefits of holistic analysis, design and operation by considering a 14,000m² 'typical' US office complex. She showed that, compared with 1990s-era lighting, a LED lighting retrofit would result in 50% savings in lighting energy and – because of the reduced space heat gain – a 15-25% reduction in cooling. This, in turn, would mean a 20% reduction in water consumption by the cooling towers.

Three US CIBSE members joined CIBSE President John Field for a seminar that showed how the hype could be stripped away to deliver high-performance buildings. The presentation, created by Bruno Lee of Concordia University, Canada, demonstrated how the apparent arbitrary nature of input assumptions can have an impact on installed systems, and how appropriately considered input data – such as meaningful weather data – can make for more robust building design.

Brian Dargan, of BuroHappold, Los Angeles, examined the role of BIM data for design and post-design purposes. By ensuring a 'clash free' model that balances data richness and simplicity, he showed how they can benefit projects, from HVAC calculations to post-occupancy maintenance.

Karine Leblanc, director and regional chair of ASHRAE'S Region X, which covers California, Arizona, Nevada and Hawaii

Alastair MacGregor of Aecom, Los Angeles, explained how a performance-based solution that focused on the health and comfort of fans, venue flexibility and environmental footprint was a game shifter in the design of a new stadium for the Sacramento Kings basketball team.

Finally, CIBSE President Field considered different design and assessment processes aimed at producing well-performing buildings. Using examples of real schemes, he showed that the bar can be raised by measuring actual performance and ensuring that there is an appropriate relationship with, and assessment of, non-energy criteria.

The 2016 ASHRAE *Standard 90.1 Energy Efficiency Standard for Buildings Except Low-rise Residential Buildings* was released at the event. It includes 120 changes, which reinforces the message that there is a need to break free from siloed engineering techniques. This was a sentiment echoed by ASHRAE President Tim Wentz, who called on delegates to 'adapt today to shape tomorrow'. **CJ**

Recordings of technical presentations are available at **bit.ly/2mgKLD5**

Digital modelling: from Level 2 BIM and beyond…

Building information modelling has been a hot topic in the built environment since the adoption of the 2011 BIM Task Group report. Hywel Davies looks at the current state of developments

The International Alliance for Interoperability introduced digital technology to construction around 25 years ago. However, the real step change for building information modelling (BIM) in the UK was adoption of the 2011 BIM Task Group report, which committed the UK to adopt Level 2 BIM for all centrally procured government projects from 2016. This set off a flurry of activity to develop guidance and standards to deliver this ambitious target.

CIBSE's Digital Engineering Series gives guidance on tackling the practical challenges of BIM processes and digital engineering more widely. These are supported by free templates to help with pre-qualification questionnaires and development of Employer Information Requirements, called for in PAS 1192-2. There is also an ongoing series of CIBSE BIM Roadshows (**www.cibse.org/BIMRoadshows**).

Taxpayer-funded documents have been produced for the BIM Task Force by national standards body the BSI. These are supplemented by guidance from the Construction Industry Council (CIC) on contractual and professional indemnity insurance, while the Centre for the Protection of National Infrastructure (CPNI) has produced practical guidance covering security aspects. These are available, free of charge, to both UK and international users, from **bim-level2.org/en/** and **bit.ly/2l8iwpt**

"CIBSE's Digital Engineering Series gives guidance on BIM's practical challenges"

Key standards

BS 1192:2007 + A2:2016: *Collaborative production of architectural, engineering and construction information. Code of practice* offers a best-practice, systematic method for development, organisation and management of production information for construction. It gives a template for common naming conventions and approaches to collaborative working, to enable efficient data use in facilities management.

PAS 1192-2:2013: *Specification for information management for the capital/delivery phase of construction projects using building information modelling* builds on BS 1192, focusing on graphical and non-graphical data, and documents developed for project delivery during design and construction. A new edition is due in the spring.

PAS 1192-3:2014: *Specification for information management for the operational phase of assets using building information modelling (BIM)* helps asset managers manage information over the longer-term operation of an asset, which can account for around 85-90% of the total cost of an asset. It is a companion to PAS 1192-2.

BS 1192-4:2014: *Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice* outlines the UK use of the construction operations building information exchange (COBie), an internationally recognised schema for sharing asset data between the owner or operator and the supply chain.

PAS 1192-5:2015: *Specification for security-minded building information modelling, digital built environments and smart asset management* describes the cyber-security vulnerabilities when using BIM, and sets out an assessment process to determine appropriate levels of cyber-security for BIM collaboration. This PAS applies to any project where asset information is created, stored, processed and viewed in digital form. It also applies to collection of digital survey data, either for day-to-day asset management or for use in a future project.

In addition to PAS 1192-5, the CPNI offers a range of other security-related guidance, with an eight-page introduction to the PAS and security-minded BIM, and a set of FAQs on BIM and security.

CIC guidance

The CIC publishes the BIM Protocol – currently being revised – for use on all common construction contracts at BIM Level 2. It identifies the models that project teams need to produce and offers specific obligations, liabilities and associated limitations on their use. Clients can also use it to require adoption of particular ways of working, such as a common naming standard.

The CIC best practice guide for professional indemnity insurance when using building information models addresses the needs of insured parties, in particular consultants producing information using BIM. It identifies key areas of risk that professional indemnity (PI) insurers associate with Level 2 BIM, and outlines what insured parties might be expected to do to ensure their PI insurance is in order.

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

Inferior submetering means substandard performance

Poor design, specification and commissioning of submeters is costing clients thousands of pounds in remedial work. Carbon 2018's Joanne Merry explains

Good submetering is critical if building owners, managers and occupiers are truly to manage building energy performance. On new-build and refurbishment projects, Building Regulations typically require electrical submetering for key areas and equipment. The introduction of the Heat Network (Metering and Billing) Regulations 2014 (HNR) has increased the number of properties requiring heat meters to be installed.

New-builds are becoming more complex, with integrated technologies, renewables and onsite generation – and the more complex a building is, the more intricate metering systems it requires.

The operational requirements of metering systems have also evolved. Under Part L, the focus was on monitoring, but metering now needs to meet the requirements for participation in schemes such as the Renewable Heat Incentive (RHI) to monitor the efficiencies of such technologies and plant. Technological changes, including advances in automatic meter reading (AMR) systems, have made possible real-time data through a variety of communication protocols.

Regulation in the guise of Part L and HNR may stipulate what needs to be metered, but it fails to explain how to do it, and doesn't address all the challenges and objectives a modern metering system needs to cover. CIBSE's revised *TM39 Building energy metering* – soon to be published, but first issued in 2009 – is timely. The guide sets out a modern methodology for metering for those involved in designing, specifying, installing or using new metering systems.

Submetering is often considered a relatively small part of a project, so it is usually addressed at a late stage and as part of the wider mechanical and electrical (M&E) systems – it is not always given the attention it deserves. From an operational perspective, failed or inadequate metering systems present several risks for property managers, not least the impact on cashflow if the energy costs paid out by tenants cannot be recovered.

A comprehensive and joined-up approach to metering is needed, starting at design stage and going through to commissioning and completion. Input from all building stakeholders is critical. Getting the design, installation and commissioning right before practical completion saves unnecessary cost and hassle further down the line.

We have seen several projects on which remedial works have cost more than the installation of the original system. Issues have included incorrect types of meters, inaccurate recording because of poor installation, and a lack of system commissioning.

"Remedial works often cost more than the installation of the original system"

Metering must be treated as a specialist system in its own right, rather than as an add-on to the M&E systems. It requires its own design, specification and commissioning processes, so engaging with a metering specialist is paramount.

At design stage, the strategy must be informed by the building stakeholders' objectives. All too often, metering is based on regulatory demands and not tailored to specific requirements of the project, leading to a jumbled 'shopping list' of incompatible requirements.

Meter type should be addressed ahead of installation, and the assessment must include: the registers from which recorded data is needed – for example, kWh only, voltage, amps or reactive power; whether Measuring Instrument Directive approval is required; the size of supply; and location. Cost is also a factor, but should not be at the expense of requirements that meet the objectives. Going for the cheapest option often ends up being the most expensive when meters have to be replaced. On numerous occasions, we have seen the cheapest standard, low-accuracy water meter bolted to a heat-meter calculator. This can result in issues with compatibility, as well as data inaccuracy, and nearly always means meters are abandoned or replaced.

Where heat meters exist in multi-let buildings with communal heating and cooling systems, or for district systems, there is a legal requirement under HNR to maintain and use them for billing. Abandonment is impossible, and the only option is remedial works.

The final piece in the jigsaw is ensuring correct installation and commissioning of meters so they record accurately. This must include checking for: the correct installation and set-up; point-to-point testing of the connectivity between the meters and AMR system; validation of the data on the AMR head-end against meter registers; review of metering documentation; and testing of the communications for remote access to data.

Metering that uses the objectives to inform strategy, incorporates stakeholders' views and includes regular reviews/updates throughout the project, will result in a system that meets the needs of the building users.

JOANNE MERRY
is technical director at Carbon 2018

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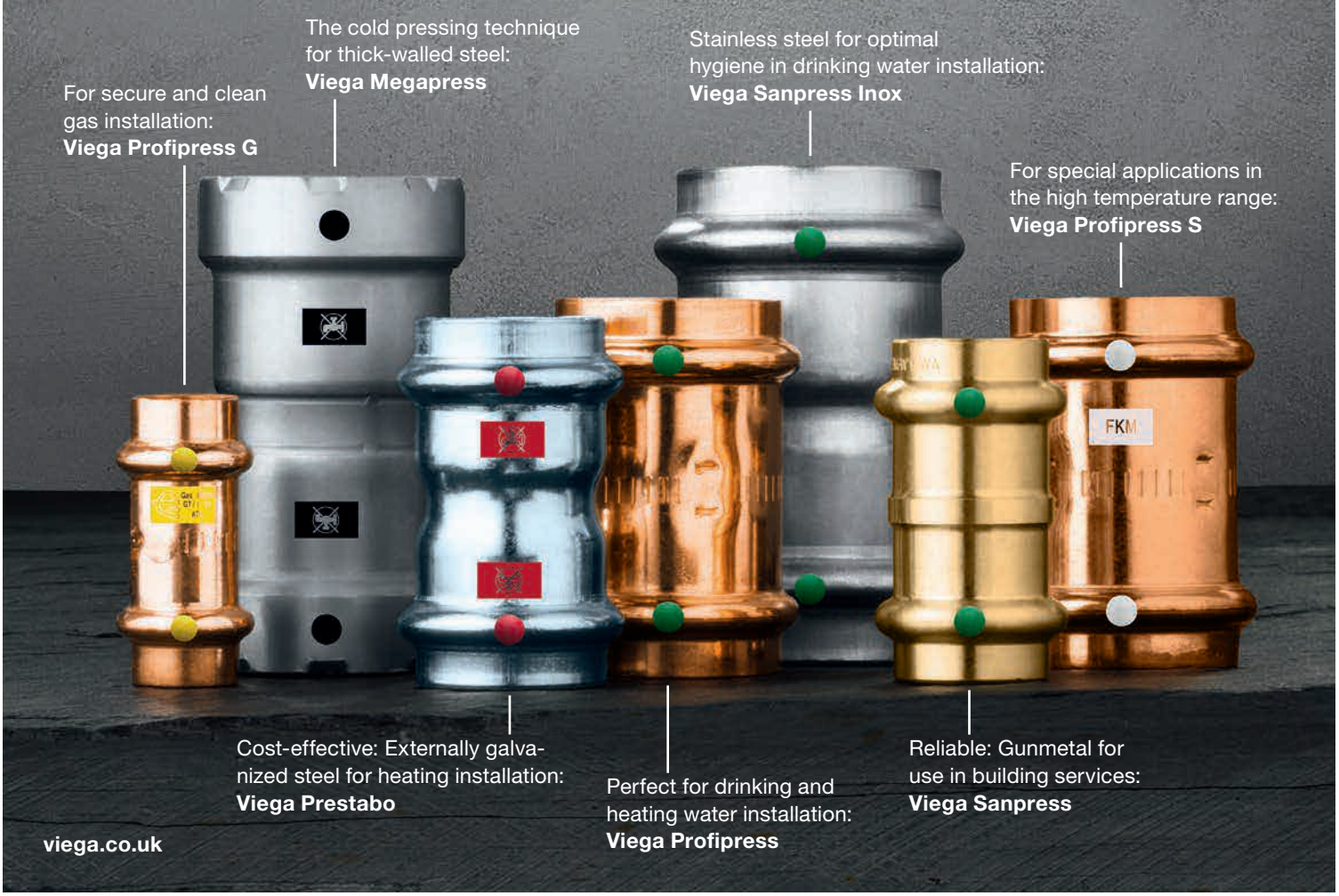

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FIRST CLASS WITH HONOURS

More than 160 awards have been presented over 10 years of the CIBSE Building Performance Awards. **Liza Young** reports on the latest winners to be recognised

On a night that celebrated the 10th anniversary of the CIBSE Building Performance Awards, 16 accolades were presented to recognise the projects, teams, products and organisations that truly excel and deliver exceptional building performance.

Five years after lifting the Carbon Champion trophy at the 2012 awards, the University of Bradford's department of estates and facilities was crowned the overall winner at Grosvenor House Hotel on 7 February 2017, and also took the Facilities Management Team Award.

Andrew Chadwick, electrical project manager at the university, said: 'It's a reward for all the hard work that the team has done – we work really hard every day and, as a client, we're not often appreciated for the work we do.'

He added: 'Over the past 10 years, the university has worked hard on setting the standard for the whole industry, so it [building performance] is important for us, because we're leading the way for other higher education organisations to follow us.'

Elementa Consulting also celebrated a double victory, picking up the Building Performance Consultancy of the Year (up to 100 employees) gong and – for the second year running – the Project of the Year: International Award for the DPR net positive energy San Francisco office.

Kevin Hydes, chief executive officer of Integral Group – of which Elementa Consulting is a member – said: 'Our people work so hard to create high-performing projects day in, day out, throughout the year, and, for them, it's everything.'

Hydes said demonstrating true performance is what sets CIBSE's awards programme apart from any other, and he encouraged others to enter next year. 'Get your best work, make sure it really works as you think it should, and then submit. It's worth everything,' he said.

Max Fordham didn't fail to impress, also scooping two awards – Building Performance Consultancy of the Year (101-1,000 employees) and Project of the Year: Public Use for Keynsham Civic Centre.

Tamsin Tweddle, senior partner at Max Fordham, said: 'It feels like a wonderful reward for all the effort we've put in. I'm particularly pleased to win the practice award because so many people from our organisation have contributed to this. It inspires people to do the very best they can and continue pushing the boundaries.'

Scott Rushford, senior engineer at Max Fordham, said the firm focused on the detail when completing its award entry for Keynsham Civic Centre.

'We have looked at the tiniest detail to determine how much energy has been used – down to the specific number of cups of tea made every year. The little details feed into the bigger picture and that feeds into the project as a whole.'

For the third year running, Aecom was crowned Building Performance Consultancy of the Year (over 1,000 employees). Sasha Krstanovic, director at Aecom, said: 'Winning a CIBSE award helps us promote our business to young engineers that are interested in working for our company, and it also helps us promote ourselves to our clients.'

She likened the awards dinner to a school reunion, adding: 'You see all your old friends and you learn about what other people do. The atmosphere is great, every year it gets bigger, which means what we do is going out there and getting more and more recognition.'

Picking up the Collaborative Working Partnership Award, Phil Thornsby, associate at Hoare Lea, said: 'We've been working together as part of a framework agreement, delivering some fantastic projects around the UK on behalf of the RNLI, for 12 years now. This is an ideal example of being able to demonstrate that collaborative working does work over a period of time, not just for 12 months.'

The Project of the Year: Commercial/Industrial gong went to Arup, for the Jaguar Land Rover engine manufacturing centre. Philip Hives, associate at Arup, said it was rewarding to be applauded for a building that was designed to meet the client's high expectations of a comfortable, highly attractive environment, that also achieves the expected energy and carbon goals.

The Energy Management Initiative Award went to Swire Properties, for its knowledge-based energy management system in its Hong Kong portfolio. Raymond Yau, general manager at Swire Properties, said

"By becoming winners today, we're a good example that even a small family-run business from Hertfordshire can do it if you have a go" – Michaela Stephens-Smith

managing the existing buildings – some of which have been in the market place for 10-20 years – demands the constant introduction of new technologies. So, the energy meters the firm installed helped inform Swire about how the buildings were performing and to instigate strategies to improve the energy-consumption reduction further.

Yau added: 'It was worthwhile to come all the way from Hong Kong to receive this high accolade, which is a strong recognition of our achievement over the years. We're really delighted.'

But the big organisations were not the only ones to get recognition – some smaller firms also got their moment in the spotlight.

The refurbishment of the main kitchen of Frederick's restaurant, Islington, by TAG Catering Equipment, was crowned Project of the Year: Leisure, and Guru Systems took the Energy Saving Product or Innovation of the Year accolade for Guru Pinpoint.

Michaela Stephens-Smith, financial director at TAG, said she felt proud to be recognised by people who know and understand buildings, not just catering equipment. 'By becoming winners today, we're a good example that even a small family-run business from Hertfordshire can do it if you have a go,' she said.

Casey Cole, managing director of Guru Systems, said: 'To get pulled out from that crowd and to have our product highlighted as being particularly innovative is an amazing honour.'

Guest speaker Dr Pawel Wargocki said good IEQ in the workplace can be an additional benefit to a firm's employees

University of Bradford's department of estates and facilities was crowned Building Performance Champion


This year, 16 awards were presented to 13 organisations at the awards ceremony

WINNERS AT A GLANCE

Building Performance Consultancy of the Year (up to 100 employees)
Sponsored by ABB
Elementa Consulting

Building Performance Consultancy of the Year (101-1,000 employees)
Sponsored by Beeby Anderson Recruitment
Max Fordham

Building Performance Consultancy of the Year (over 1,000 employees)
Sponsored by Andrews Water Heaters
Aecom

Building Performance Training Programme award
Sponsored by Arkwright Scholarships Trust
Breeam Associate – BRE Academy

Collaborative Working Partnership award
Sponsored by Lochinvar
RNLI Porthdinllaen, Gwynedd – Hoare Lea

Energy Management Initiative award
Sponsored by Imtech
Knowledge-based energy management of Swire Properties Hong Kong portfolio – Swire Properties

Energy Efficient Product or Innovation of the Year
Sentinel Kinetic Advance – Vent-Axia

Energy Saving Product or Innovation of the Year
Guru Pinpoint – Guru Systems

Facilities Management Team award
Sponsored by Gratte Brothers
University of Bradford's low carbon estate – University of Bradford, department of estates and facilities

Project of the Year – Commercial/Industrial
Sponsored by Vaillant
Jaguar Land Rover Engine Manufacturing Centre (JLR EMC), Wolverhampton – Ove Arup & Partners

Project of the Year – International
DPR net positive energy San Francisco Office, USA – Elementa Consulting, member of Integral Group

Project of the Year – Leisure
Sponsored by Gree UK
Refurbishment of main kitchen of Frederick's restaurant – TAG Catering Equipment

Project of the Year – Public Use
Sponsored by Rinnai
Keynsham Civic Centre – Max Fordham

Project of the Year – Residential
Tigh-na-Croit, Gorstan (nr Garve) – HLM

Building Performance Champion
Sponsored by Remeha
University of Bradford's low carbon estate – University of Bradford, department of estates and facilities

Test of Time award
Sponsored by CIBSE Patrons
British Land

Max Fordham was crowned Building Performance Consultancy of the Year (101-1,000 employees)

Elementa Consulting scooped Project of the Year: International

Aecom was named Building Performance Consultancy of the Year (over 1,000 employees)

» The evening – which was attended by more than 750 people – was praised by delegates. 'It's fantastic that everybody gets together from different sectors and they all cheer the winners on,' said David Clark, sales director (new build) at Vent-Axia, which won Energy Efficient Product or Innovation of the Year for Sentinel Kinetic Advance.

Unfortunately, not everyone was able to attend. For Tony Woodley MCIBSE, of Aces Fans, who became a CIBSE member in 1950, this was the first annual dinner he has missed – because of illness – since 1946.

Other notable winners included British Land, which won the Test of Time Award; HLM's Tigh-na-Croit, Gorstan, which won Project of the Year: Residential; and BRE Academy's Breeam Associate programme, which won the Building Performance Training Programme accolade. Hayley Tanner, operations manager at BRE Academy, said 500 people had already been trained on the course, 'so this award is perfect'.

Guest speaker, Dr Pawel Wargocki, associate professor at the Technical University of Denmark, spoke about the effects of indoor environmental quality (IEQ) on humans. He said both old and new buildings face fresh challenges, so they need to become much more flexible and resistant to changing temperatures and populations, while also protecting against a wide range of both man-made and natural pollutants.

As well as adapting buildings to the 'hypersensitive' young and the increasing older population, Wargocki said we must reduce the overdependence on existing, 'rather crude' technological solutions and minimum standards.

He said the main objective of the built environment is to create great conditions for people – an objective that's often eclipsed by tangible savings. 'Buildings are not erected to save energy; they are constructed to create shelter and to promote conditions for work, studying, healing and resting.'

He added: 'Energy is important, and should not be neglected. But it should go hand in hand with human-centric design.' CJ

INDUSTRY PIONEER WHO'S STILL AHEAD OF HIS TIME

Max Fordham FCIBSE is Britain's most influential services engineer, and his practice continues to lead the field when it comes to innovative building services design. **Alex Smith** finds out what's next for the man who has been bringing creativity and intellectual rigour to the industry for over 50 years

A familiar name led the roll of honour at CIBSE's Building Performance Awards last month. Max Fordham won in two of the most competitive categories – Building Consultant of the Year and Building of the Year: Public Use – to continue its long run of success at the annual event. The accolades capped a stellar 12 months for the building services engineer, which also won the Stirling Prize for its Newport Gallery project and picked up RIBA House of the Year for the second year running.

When I met the company's founder for this interview, the first thing I did was congratulate him on his latest success. I was met with a polite, but dismissive, wave of the hand. Awards offer a fleeting pleasure, but – as I was to find out – what really drives Max Fordham is the sense of achievement derived from designing and making things.

Fordham is an inventive, brilliant engineer, who patented inventions and bought a new rigour to measuring building performance. He is also an engineering polymath. He brought together the separate disciplines of mechanical, electrical and public health engineering, and was one of the first to tackle building services design in an integrated way.

'I remember going to meetings with engineers for electrical, public health and mechanical ventilation – it seemed bonkers,' says Fordham, recalling his first consultancy in the 1960s. He vowed to learn to produce detailed drawings for all the services, so he could integrate his designs.

His obsession with engineering was evident at the CIBSE Building Performance Conference, where he was asked on stage what his favourite project was. 'I'm not proud of any particular building,' Fordham replied. 'The intensity and the fun of the design process is what I really remember.' He cited one job – Hulme 5, a 1,000-flat, council block in Manchester. It gave Fordham the opportunity to come up with a new method of sizing and drawing up pipes. 'I felt the guidance of the time was leading to absurdly oversized pipes. I decided on another method, which gave me a terrific buzz,' he told delegates.

This episode demonstrates Fordham's ability to combine a creative, innovative approach to services design with a rigorous application of scientific principles. This has been a hallmark of his career and can be traced back to his formative years.

Background

Fordham was born in 1933. His mother, Molly Swabey, was a journalist at *Vogue* and the *News Chronicle* national newspaper, and his father was Michael Fordham, a renowned child psychiatrist. When war broke out, Fordham was sent to Jamaica to stay with an uncle, and attended a traditional prep school. Tragically, his mother was killed in 1942, when her ship returning to England was torpedoed by the German navy, and Fordham spent the rest of the war in Jamaica, far from close family.

He did not enjoy the harsh prep-school regime, but it instilled in him a sense of discipline. Fordham's next educational experience could not be more different. He was sent to the progressive Dartington Hall School in Devon, which he remembers as having a 'completely undisciplined environment'. The only mandatory activity was what was called 'useful work'; this focused on maintenance of school buildings. Fordham took full advantage to learn wood- and metalwork techniques. He learned about push-fit and compression pipework, and made an electric hotplate for the kitchen. He likened it to an apprenticeship.

The sense of discipline drilled into him at prep school ensured that Fordham gained a School Certificate – the equivalent of five GCSEs – and this enabled him to do A Levels in double maths, physics and chemistry. He subsequently read natural sciences at Cambridge, specialising in chemistry, physics, maths and mineralogy.

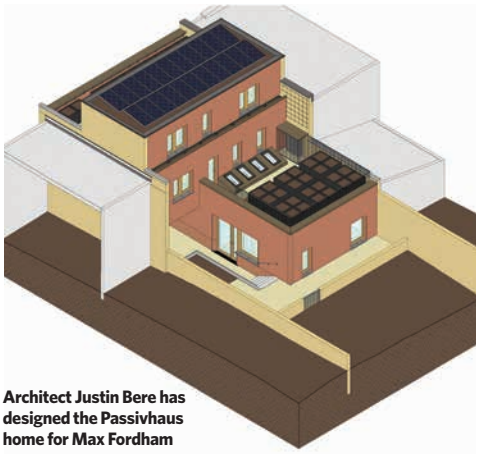
'I proceeded to do badly at science academic subjects, but had tremendous fun,' joked Fordham, who enjoyed the company of humanity students outside of lectures. He shared a house with Dartington Hall schoolfriend Simon Nicholson – son of artists Ben Nicholson and Barbara Hepworth – who introduced him to a circle of architects and artists, including Sir Leslie Martin. the lead designer of the Royal Festival Hall and head of the Architecture School at Cambridge University. Fordham enjoyed many 'a robust argument' with Sir Leslie, but also discussed his career prospects and was advised to apply his knowledge of physics in the heating and ventilating industry, which was lacking in skills.

Sir Leslie recommended him for a job at Weatherfoil Heating Systems. 'It gave me a wonderful introduction to engineering thinking,' says Fordham, who was able to use his academic knowledge for a wide range of design and research work. »

"Dartington Hall's only mandatory activity was 'useful work'. Fordham likened it to an apprenticeship"

CAREER TIMELINE

- 1933 Born in Highgate to Michael Fordham and Molly Swabey
- 1939 Sent to preparatory school in Jamaica to escape World War II in Europe
- 1945-52 Attended Dartington Hall School in Devon
- 1952-54 National Service as pilot in the Fleet Air Arm
- 1954-57 Completed degree in natural sciences at Trinity College, Cambridge
- 1958 Spent a year at the National College of Heating, Ventilation, Refrigeration and Fan Engineering
- 1958-1961 Joined Weatherfoil Heating Systems as a development engineer
- 1961-66 Joined Building Group (now Arup Associates) as building services engineer
- 1966 Created Max Fordham
- 1973 Turned Max Fordham into a partnership
- 1984 Became a fellow of the Royal Society of Arts
- 1994 Made an OBE
- 1992 Elected fellow of the Royal Academy of Engineering
- 1997 Awarded CIBSE Gold Medal
- 2001 President of CIBSE
- 2008 Won the Prince Philip Designers Prize



Architect Justin Bere has designed the Passivhaus home for Max Fordham

» Fordham met his wife, Thalia Dyson, at this time, and she introduced him to her landlord, architect Sir Philip Dowson, the founding partner at Arup Associates. He needed a heating engineer, and offered Fordham a job. It was here that he developed his drawing skills, and started to take on electrical, public health and mechanical elements. His ability to draw all types of services was getting him extra work outside Arup Associates, particularly with architect Peter Foggo, who was designing houses. On one project, Fordham drew the flue precast concrete blocks that were built into the walls as a warm air duct. 'The bricklayers and ductlayers would not have had a clue,' he says.

Fordham finally went out on his own in 1966, and his fledgling consultancy got a big boost when he was asked by Arup Associates to design the heating on the Hulme 5 scheme. Soon after, he was introduced to the brutalist architect Neave Brown, which led to a commission to work on Brown's Alexandra Road flats and Newport High School.

In 1973, a co-operative was established at Max Fordham, where equity was paid out every year with a small amount of capital retained for the practice. The partnership principle stands to this day. The Max Fordham practice has designed a string of innovative buildings since it was established and has a particular focus on the performance of buildings and soft landings. 'Before specifying any product, I want to see evidence of performance, installation and operation,' says Fordham, who intends to expand the company's portfolio of 'innovative architecture employing innovative environmental design'.

Much of Fordham's thinking time is now taken up with analysing the sustainability of human activity on Earth. He considers the planet as a thermodynamic system that is roughly in equilibrium. 'Any intervention we make should be put into context, much like environmental impact studies that are made on new schemes.' He has calculated that if mankind continues to burn fossil fuels at the same rate, carbon resources would run out in about 400 years. And, if all of it was burned for energy, the CO_2 released into the atmosphere would make air unsafe for humans. 'We must decarbonise electricity,' says Fordham, who believes some nuclear power and coal-fired power stations will be necessary until buildings are improved and the electricity grid decarbonised.

In his *CIBSE Journal* article (October 2016) celebrating the 40th anniversary of CIBSE, Fordham said demand for winter heat could be reduced to almost zero by thermal insulation, control of ventilation, and the use of heat from human respiration, and electrical work. He calls the latter the 'metabolism of the building'.

Fordham will soon be putting his theory into practice as he is about to build himself a Justin Bere-designed Passivhaus home without heating in Camden, close to where he lives. Fordham may be in his 84th year, but he's still thriving on engineering challenges that focus on sustainability and human values. CJ

Max Fordham at his practice's 50th anniversary party last year held in the Switch House Tate Modern extension

DOUBLE FIRST

The University of Bradford won the ultimate CIBSE Building Performance Awards accolade for the second time last month. **Andy Pearson** finds out how the facilities management team has maintained its focus on energy reduction, and reveals its plans to go off-grid

The University of Bradford has made CIBSE Awards history after being named Building Performance Champion for the second time at this year's CIBSE Building Performance Awards. Its department of estates and facilities won plaudits from the judges for its transformational work on the institution's ageing estates infrastructure over the past decade, resulting in its carbon footprint being reduced by 35%.

The university's estates and facilities team first won the Champion accolade in 2012, for achieving an 8% reduction in emissions from its estate, and for the work the estates team had done to bring about change through its involvement in the institute's Ecoversity programme. In 2006, the department had set out how it planned to regenerate the university's estate, and how it would work with students and staff to achieve a 50% reduction in direct emissions from gas and oil use, and electricity consumption, by 2020.

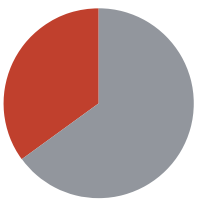
'Nothing fundamental has changed since 2012 – we've just carried on trying to save carbon,' says Russell Smith, head of estates at the university. What has changed, though, is the rationale for the ongoing work. 'Previously, we were driven by the green agenda and Ecoversity; now, our energy-saving work is driven by ensuring security of energy supply – and electricity in particular – in light of predicted volatile utility prices with the closure of coal-fired and nuclear power stations,' Smith explains.

He says the university has already suffered several power losses and 'brownouts'. 'If we lose power during the admissions clearing period, the university could lose £30m or £40m in revenue,' says Smith, who adds that the ultimate aim is to take the university off the power grid. 'The key is taking control of your own destiny.'

The off-grid business case is not simply about security of supply, however – it is also about 'the creation of a revenue stream by having the capability to export energy to the grid', says Smith. The goal is for the university to become a net exporter of energy, rather than an importer, and for its estate literally to generate money for the institution. 'We're moving towards that at the moment,' says Smith, 'In the winter evenings, and at weekends, we export electricity to the grid from our CHP.'

The next step in the university's preparations for moving off-grid is the 'micro smart grid', currently under construction. This electricity and heat grid will connect four major buildings on the main City Campus – including the library and the student building – with a micro-combined heat and power (CHP) system. Backing for the project – set

Carbon footprint reductions



35% reduction

The University of Bradford has reduced the carbon footprint of its ageing estates infrastructure by 35% over the past decade

to go live this month – includes £1.9m from the Higher Education Funding Council for England/Salix Revolving Green Fund 4.

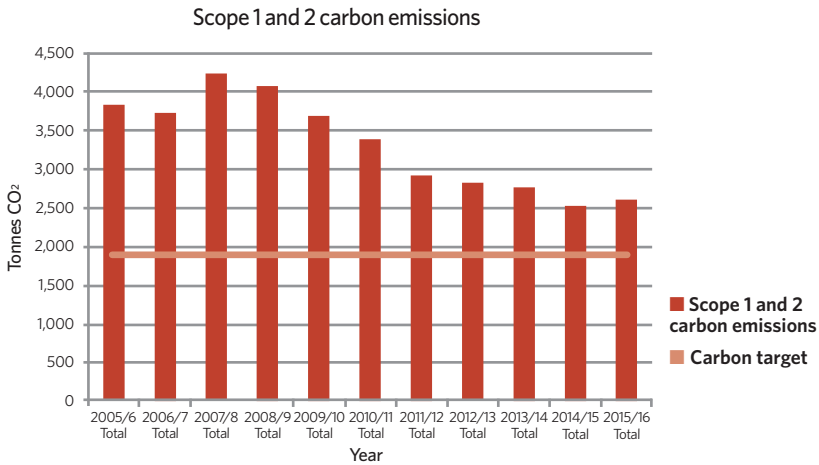
The business case for the micro-CHP means that it will be used to generate electricity for export when it is demanded by the grid, and not necessarily when there is a high demand for heat from the CHP engine. 'The CHP will be fitted with dry coolers to reject heat,' says Smith, who adds that the business case is the same for the main CHP, to which the facilities team is looking to fit big dry coolers for the same reason.

Alongside the option of exporting surplus electricity, the team is also investigating the possibility of battery storage. The favoured option is for the batteries to be supplied under an energy service company (ESCo) arrangement. According to Smith, battery storage 'will help take the university off the grid'; with the batteries in place, the grid would only be used as backup to run the CHP, which would otherwise operate in what is referred to as 'black-start' mode.

A key part of the university's security of supply initiative is the ongoing drive to reduce its demand for energy. 'We still abide by the "fabric first" mantra and our mission statement of "save before you generate",' says Smith.

The University of Bradford comprises 28 buildings – with a total floor area of 124,000m² – split between two campuses, with the majority located on City Campus. Most of the buildings were built between 1964 and 1977, when building performance and energy efficiency were not major considerations, and feature warm-air heating, single glazing and »

"The goal is for the university to be a net exporter of energy and for its estate literally to generate money"



The facilities team has continued to focus on CO_2 reduction since its 2012 CIBSE Award win

CASE STUDY: HOW A 1970s LIBRARY BUILDING WAS TRANSFORMED FROM DEC 'E' TO DEC 'A' FOR £1.7M

The JB Priestley Library – with a Band E Display Energy Certificate (DEC) rating – was one of the most inefficient buildings yet to be revamped on the University of Bradford's campus. The estates team evaluated refurbishing the 22,000m² building, constructed in 1973, to bring it up to a DEC 'A' rating and compared that to the cost of demolishing the library and rebuilding. It estimated that refurbishment could deliver the same level of performance as a new building, but at a fraction of the time and cost.

To improve the library's thermal performance, the estates team insulated the building fabric with three times the insulation thickness required under Building Regulations. It also sealed the building to Passivhaus benchmarks, to prevent draughts and uncontrolled ventilation in line with the standard's 'fabric first' mantra. Improvements to the fabric insulation reduced the building's demand for heat, which – in turn – reduced the size and cost of the replacement heating system. The new system includes a biomass boiler and a 600m² solar PV array – installed after the crash in the price of solar PV following the withdrawal of the commercial feed-in tariff (FiT) – in place of the life-expired gas boilers.

A new central atrium was punched through the building to facilitate natural ventilation to the top two floors and to allow daylight deep into the interior. The interior was designed with workspaces close to the windows and the atrium, to allow students to take advantage of increased daylight levels. Bookshelves were also positioned to allow daylight into the spaces.

In an annex to the library is the principal student social building, Student Central. Here, a new mixed-mode ventilation system has been installed, controlled by the building energy management system (BEMS). Opening and closing of the building's windows is also controlled by the BEMS. The atrium is used as a solar chimney; in summer, warmed air rises up and out of the building to allow cooler, fresher air to be drawn in at low level. Internal temperature fluctuations are moderated by the thermal mass contained within the building's core. When internal temperatures exceed 28°C, the BEMS closes the windows and switches to a mechanical ventilation system.

The project is metered extensively and the data used to plot actual performance against expected performance. This enables the facilities team to understand when and why differences occur. Significant deviations from the expected energy consumption will result in a visit to the site and/or interrogation of the BEMS to identify the cause.

The refurbishment has improved the library's energy performance dramatically. Results show a decrease in gas consumption of 55% and a reduction in electricity consumption of 18%.

The initial refurbishment was assessed as DEC 'B'. However, lighting controls and solar PV have since been installed and – after further work by the estates department to understand the plant operation and fine-tune the building – the scheme achieved its target DEC 'A' rating in 2015.

» poor levels of fabric insulation. In 2014/15, the 'fabric first' approach resulted in the estates team over-cladding two 1960s buildings – one a 13-storey block, the other a three-storey workshop facility.

'We are proud of our achievements in reducing our carbon emissions and reducing our utility costs by 27% in a [energy] market that has risen by 90% over the 10 years that we have been running this initiative, accruing an aggregated saving of £8m over the business-as-usual figure,' says Smith, (See box-out 'Rolling programmes run by the university to address estate legacy issues').

The facilities team works closely with building users to understand how they need them to operate, so the performance can be optimised. 'This can be challenging at times because of the diverse nature of the university's business and wide range of demands,' says Smith. 'Managing users' expectations – and getting them to appreciate how their environment works – can be extremely challenging, and often requires early engagement and a face-to-face explanation, in non-technical speak.'

ROLLING PROGRAMMES RUN BY THE UNIVERSITY TO ADDRESS ESTATE LEGACY ISSUES

- **Installation of LED lighting internally and externally (concentrating on lecture theatres, corridors and most-used routes)**
- **Installation of lighting controls**
- **Replacement of transformers**
- **Pump replacement**
- **Engineering and control improvements to the district heating network**
- **Replacement of calorifiers by plate heat exchangers**
- **Expansion of the BEMS**
- **Review and optimisation of compressed air**
- **Rolling energy audits**
- **Identifying water use**
- **Air conditioning review**
- **Consultation with users over operating times**

To make it easier for the team to keep all of the buildings running efficiently, the university has moved its site-wide Trend BEMS to a server-based operation. This allows any member of the team to access the BEMS from either a handheld device or through a desk-based PC.

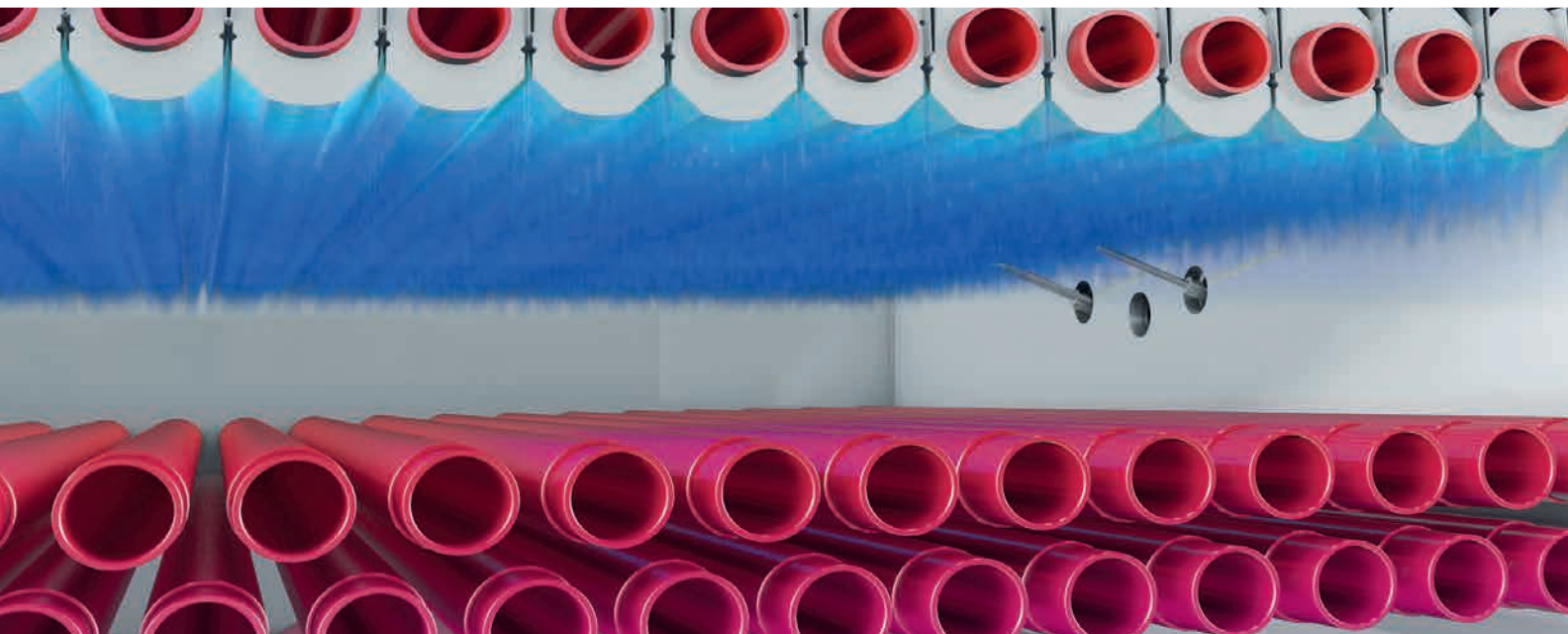
'We have a strategy where we operate the BEMS in conjunction with a web-based, real-time circuit by metering a number of our fume cupboards and other high-energy plant, as well as small power and lighting equipment across the estate,' explains Smith. 'This allows us very quickly to identify, and act on, anomalous use, as well as to see if equipment is being operated correctly, and to advise the users if it is an operational issue,' he says.

The facilities team works particularly closely with the Students' Union, to ensure it groups together out-of-hours activities in areas that have discrete heating and ventilation systems and controls, rather than heat numerous buildings.

In addition to managing the university's estate, the facilities team engages with the academic staff so the estate can be used as a teaching tool, particularly for students' final-year dissertations. Engagement is usually through access to the BMS and metering data.

Members of the facilities team also give an annual lecture outlining their work to first-year engineering students as part of their sustainability module.

Smith says it has taken a massive team effort to achieve the accomplishments to date. 'Since our [CIBSE Awards] success in 2012, we believe our achievements are all the more impressive in terms of carbon reduction and building performance improvements because



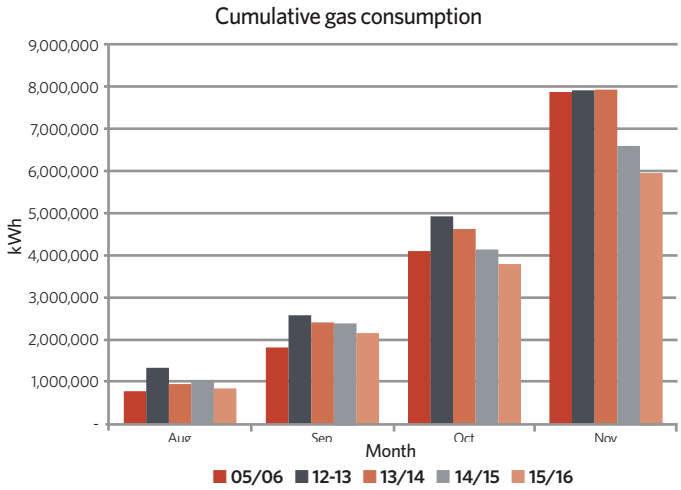
up to £40m

Amount of revenue the university could lose if it loses power during the admissions clearing period

27%

Reduction in utility costs in a market that has risen by 90% over the 10 years that the university has been running its initiative

> "Managing user expectations requires early engagement and a face-to-face explanation, in non-technical speak"



Gas consumption has decreased year on year

we harvested all the low-hanging fruit at the project's outset.'

Having achieved the 'double double' of awards wins, the facilities team is continuing its mission to drive down energy consumption at the university. It has launched the Bradford: 50@50 initiative – to celebrate the university's 50th anniversary this year – and has set itself the ambitious target of achieving the 50% carbon emissions reduction by August of this year.

'Currently, we are at a 41% reduction, but we are expecting the micro smart grid to have a big impact – so it will be agonisingly close as to whether or not we achieve this target,' Smith says. 'If we don't get to 50% this year, we'll certainly get to it early next year.' **CJ**

For details about the CIBSE Building Performance Awards, visit **www.cibse.org/bpa**

UNIVERSITY CHALLENGE

Building a higher education campus in a remote region of a landlocked country that bans the use of electricity for heating was never going to be straightforward, as Aecom's **Michael Stimpson** explains

In the UK, access to quality higher education can easily be taken for granted – but it can be a different story for those living in the most remote parts of Central Asia with ambitions to attend university. However, since the completion of a new state-of-the-art university campus in Naryn, Kyrgyzstan, an internationally recognised standard of tertiary education is much more accessible for mountain communities in the region.

The facility is the first of three University of Central Asia (UCA) undergraduate campuses to open in this region, as part of the UCA's mission to foster socio-economic development in Central Asia – particularly in its mountain societies. The campus has already welcomed its first students, from a catchment area that includes Afghanistan and Pakistan.

However, building a modern university in such a remote location presented a number of technical challenges during design and construction, which required some innovative engineering solutions.

Naryn is situated along the historic Silk Road and is separated from the rest of Kyrgyzstan by mountain ranges. Until recently, it was a six-hour drive – along unpaved roads – from the country's capital, Bishkek.

It is not only the town's location that poses logistical challenges, but the country as a whole. Kyrgyzstan is landlocked – sandwiched between China and Tajikistan to the south and Kazakhstan to the north – so long land journeys are required to get to the nearest coastal ports and other areas of major commerce. It can take several months for big items to be transported over land, so selection of equipment for the campus – and the availability of maintenance and replacement parts – were important considerations for the project.

Naryn is at an altitude of more than 2,000m and this elevation – coupled with the town's location in the middle of a large, continental land mass – results in a wide range of climatic conditions. During the summer, temperatures are typically between 25°C and 30°C, while, in winter, it can plummet to -30°C. Given this temperature range, creating a comfortable, safe environment for occupants of the university was a particular challenge.

Because of the campus's remote setting, there is limited infrastructure and access to utilities, so – with the exception of electricity – the site is entirely self-sufficient. Its potable-water needs are met from new boreholes within the grounds of the campus and there is sufficient water storage beneath the main academic building

to ensure a secure supply over a prolonged period. The boreholes are also used for the site's irrigation requirements. Grey and black water is treated on site, using the university's own treatment plant – which meets internationally recognised standards – before being safely discharged into the Naryn River.

Heating and cooling the facility proved to be the greatest challenge – and even the availability of a reasonably secure supply of hydro-electricity didn't solve all the issues, as the Kyrgyz government's energy policy precludes the use of electricity for heating. In the absence of any district heating, mains gas or biomass, Naryn's residents often resort to burning coal or dried animal waste for heat during the winter.

The project team considered several options for heating and cooling the campus that would both be sustainable and minimise the impact on the local electricity grid. It concluded that a heat pump system would be the optimum solution – so finding a system that is easy to maintain and uses products readily available in Central Asia became a priority.

Traditional air source heat pumps were ruled out because they can't function in very low temperatures. Taking water directly from the Naryn River was also considered for water source heat pumps, but this would only be effective in summer because the river freezes in winter. After analysing the ground-water temperature at the site over a 12-month period – and obtaining favourable results – it was decided to use an open-loop ground source heat pump system.

Ordinarily, off-the-shelf heat pumps that produce heating and cooling simultaneously would be the ideal solution. However, such equipment is not available in Central Asia; nor is the technical network to support it. Instead, Aecom selected standard water source heat pumps, which were available in the local market and, so, maintainable. The units were arranged schematically to deliver heating and cooling to the building and its systems simultaneously, while maximising efficiency.

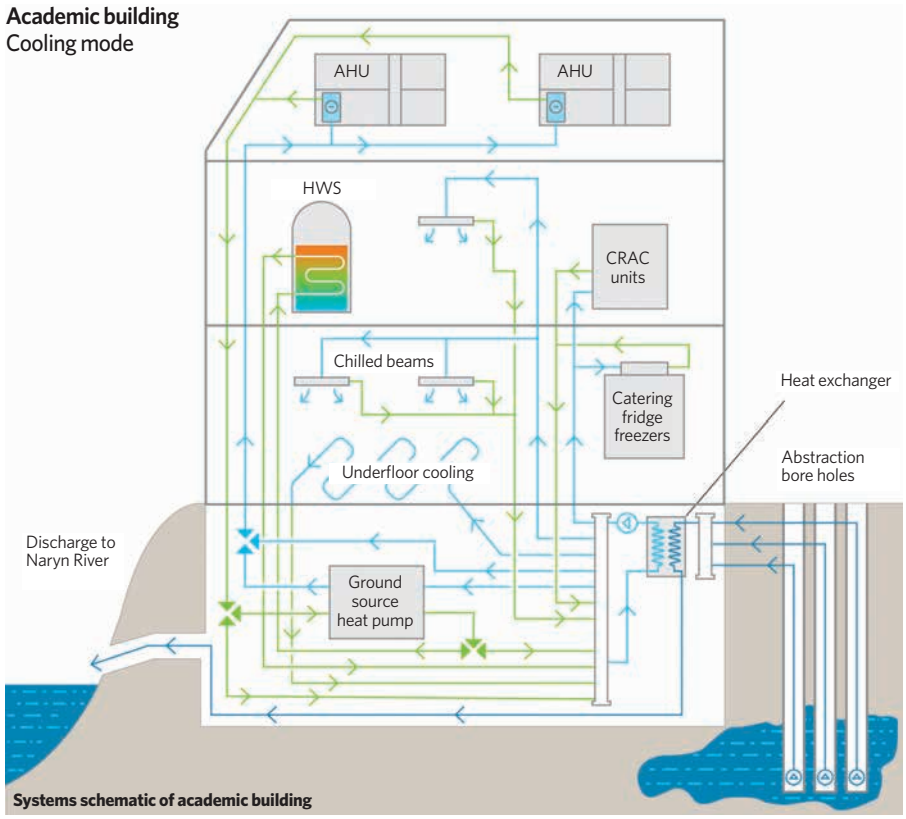
There are several operating scenarios for the heat pumps and boreholes, which are summarised below:

Cooling mode

Heat-rejection equipment associated with the catering-refrigeration and computer-server rooms uses borehole water to remove rejected heat from the refrigeration equipment throughout the year.

> "In the absence of any district heating, mains gas or biomass, Naryn's residents often resort to burning coal or dried animal waste for heat during the winter"

When operating temperatures allow, water is taken directly from the aquifer – via heat exchangers – to the air handling units' (AHUs') cooling batteries, chilled beams and underfloor cooling, bypassing the need to run the heat pump. Only when cooling loads go outside pre-determined set points do the heat pumps need to operate – and then only for the AHUs. The chilled beams could benefit from free cooling at all times of the year. »



Systems schematic of academic building

» Heating mode

During the shoulder seasons, the low temperature hot water (LTHW) circuits for the AHU heater batteries and radiators are run at the same temperature as the underfloor heating – 45°C – to maximise the efficiency of the heat pump. Only in winter, when the outside temperature goes below 5°C, is the temperature of the heat pumps increased. Supplementary electrical boilers are an important feature of the heating provision to the campus. Should the heat pumps or boreholes fail, the electrical boilers have sufficient capacity to maintain occupational temperatures at the height of winter.

In summer, the waste condenser heat generated by the heat pumps is used to pre-heat the domestic hot water circuits by elevating the temperature of the incoming water. The calorifiers then elevate the water temperature further, using electrical immersion heaters, to reach the final hot-water service temperature. When there is no 'free heat' available from the refrigeration cycle – and the heat pumps are in heating mode – the calorifiers take their heat directly from the heat pump LTHW header.

Conclusion

Despite the challenges of finding a solution and then implementing it, being able to create a safe and resilient environment for the university's staff and students is what made the scheme particularly rewarding. Aecom delivered a range of multidisciplinary services for the project, including masterplanning, landscape design, civil, structural and MEP engineering, and a range of specialist disciplines.

The campus includes a new academic building with a library, dining hall, laboratories, classrooms and faculty housing, as well as student dormitories. As part of the UCA's broader commitment to boosting local economies and developing host mountain towns into vibrant university centres, the project team engaged with local communities throughout design and construction. Aecom's team visited schools and delivered presentations to students about the evolving campus design, including civil and structural engineering and landscape design.

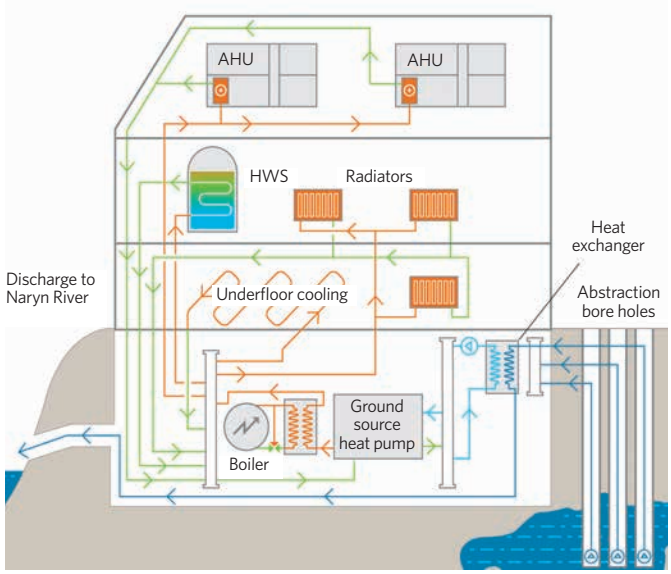
It is immensely satisfying to have worked on a project that will give isolated mountain communities access to an international standard of education. The campus will bring a range of benefits to the area, acting as a catalyst for social and economic development in remote mountain regions. **CJ**

MICHAEL STIMPSON is associate director of building engineering at Aecom

2,000m

The altitude of Naryn, which – coupled with the town's location in the middle of a large, continental land mass – results in a wide range of climatic conditions

Academic building Heating mode



Systems schematic of academic building

POSE THE QUESTION TO FIND NEXT TOP MODEL

Assumptions in building energy simulations need to be challenged if we are to improve modelling and close the performance gap, says **Simon Rees**, BSERT's editorial board chair

More than 30 years of development of building energy simulation have resulted in sophisticated software tools that are now well integrated in the design process. Applications of simulation methods in Energy Performance Certificate (EPC) calculations are now part of everyday design procedures in the UK.

At the same time, awareness of real building energy performance has increased, as more data has been made public and Display Energy Certificates (DECs) – with their colour-coded A-G band markings – have become a familiar sight.

In light of significant efforts to improve energy awareness, it is reasonable for clients and the public to expect buildings that are proclaimed to be 'A-rated' at the design/construction stage (indicated by the EPC) to be 'A-rated' during operation (indicated by the DEC). However, whether you compare rating bands or absolute emission rates, this is often not the case. This broad realisation has generated much discussion about what has been termed the 'performance gap'.

A number of factors play a role in the performance gap, such as the different types of emissions data used in the production of rating values and limitations in the underlying models (see panel, 'Key reasons for performance gap').

First of all, it is important to recognise that EPC Asset Ratings have a different scope from DEC Operational Ratings. In particular, computer equipment demands are not included in EPC rating calculations and many secondary building services demands are excluded – for example, those of lifts, external lighting and communications equipment. EPC calculations also use standardised data for internal conditions, climate, heat gains and schedules. These differences in methodology can be significant, so some systematic variations between design and operational ratings should be unsurprising.

When it comes to energy simulation of multizone buildings, the number of parameters that software users have to define is very large, and are not known with certainty. For example, elementary fabric thermal properties – such as specific heat capacity, density and thermal conductivity data – have to be defined, but are known to be uncertain, not only because of variability in the source of products, but also because of variations in moisture content. Consequently, uncertainty in model outputs is inevitable.

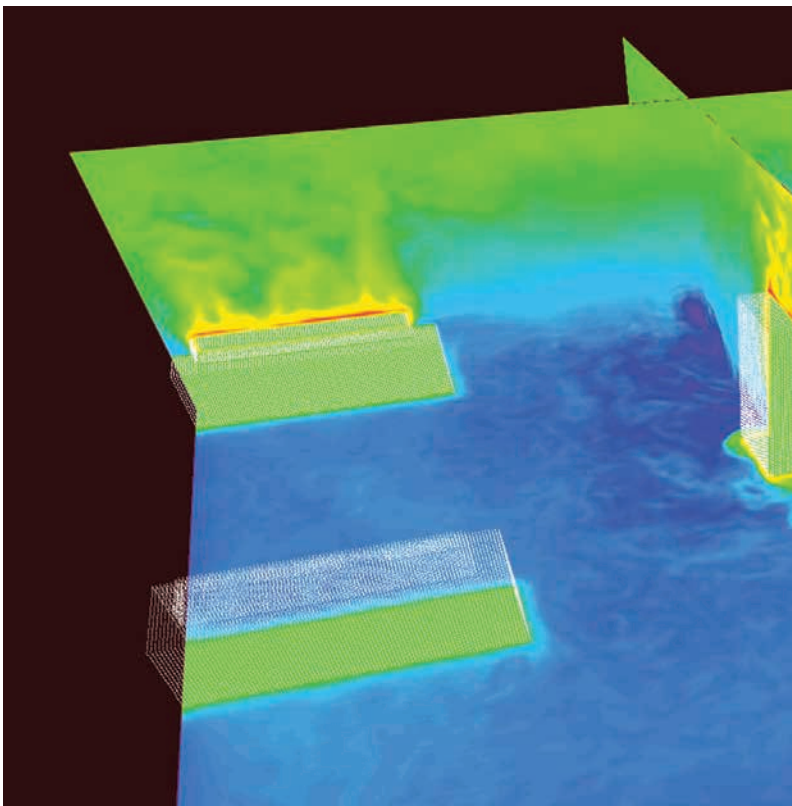
Many of the different heat gains represented in building energy simulations are not only dependent on intensity or peak output, but also highly dependent on use patterns – and, as a result, on occupant behaviour and operating practices. If you are simply aiming to make side-by-side comparisons of designs, as in EPC calculations, some of this uncertainty is insignificant and you are mostly interested in getting good guidance in design decisions. However, these uncertainties loom large when it comes to predicting performance in absolute terms.

Having acknowledged that model parameter uncertainties are important, we must also ask: are the simulation methods and software reliable? Indeed, these sorts of question have been posed since the days when building energy simulation was done with punched cards and mainframe computers.

One way to address this is to make inter-model comparisons involving very simple test cases, as in ASHRAE's standard method of test[1]. Yet the results achieved from various types of software are alarmingly different – agreement is often better than 25% but, in some cases, much worse[1].

Given that these are simple test cases, analysed by expert users, the question of model reliability becomes largely a question of systematic differences because of limitations in the underlying models of the physical processes.

> "Results achieved from various types of software are alarmingly different"



KEY REASONS FOR PERFORMANCE GAP

- **Differing types of emissions data used in the production of rating values**
- **Uncertainties in building design parameters used in modelling**
- **Uncertainties in operational data used in modelling**
- **Unintended errors in the calculations**
- **Limitations in the underlying models**

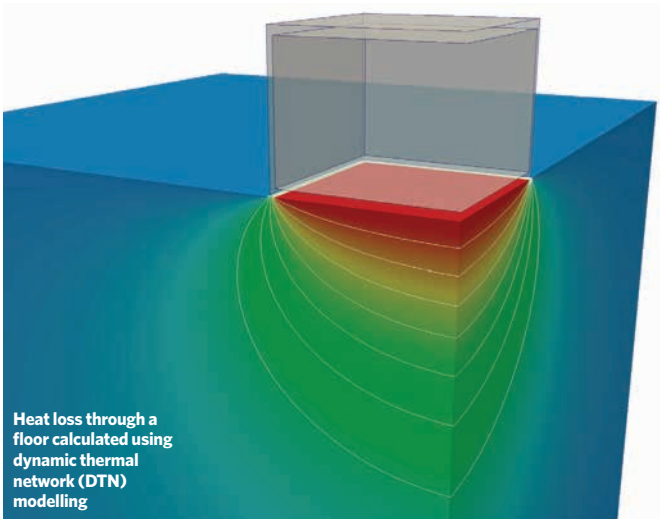
Some of the key assumptions are commonly employed in building energy simulation tools are that:

- Conduction heat transfer is one-dimensional
- Air in the room is fully mixed
- Moisture transport and its effect on thermal conditions are ignored.

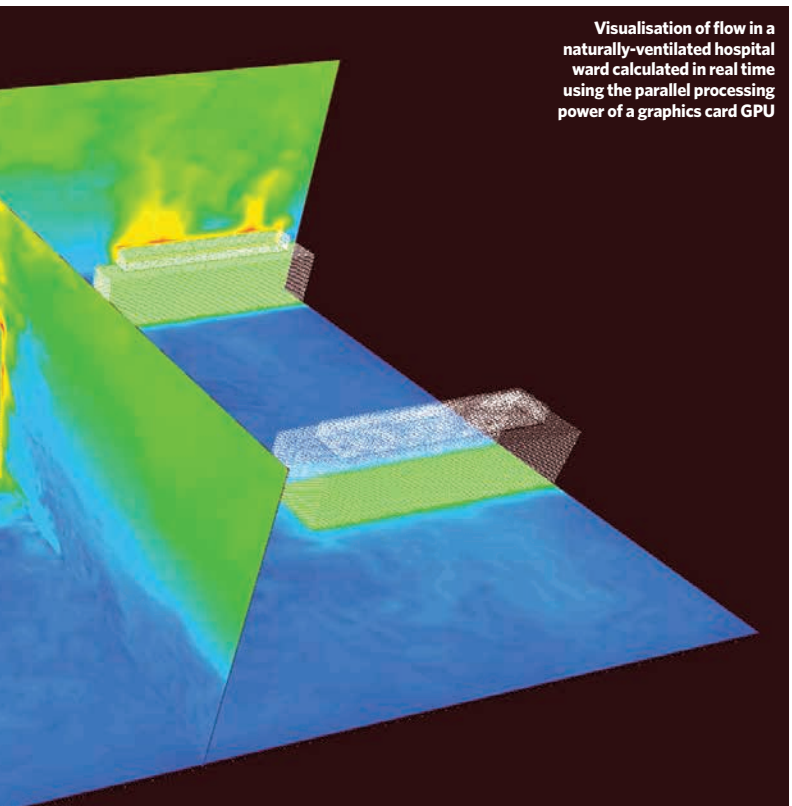
These assumptions were reasonable when the prime interest was evaluating the energy used in fully air-conditioned buildings, but now that we are in the era of highly insulated, low-leakage, mixed-mode buildings, some of these simplifications should be questioned again.

The idea that conduction heat transfer is one-dimensional is almost universal in building energy simulation. It is equivalent to modelling a building surface as isothermal and represented by a single surface temperature. However, features such as corners and junctions between fabrics can perform very differently from plane walls. It is also well known that the degree of framing in a wall construction changes both its dynamic and steady-state behaviour.

It has always been possible to make corrections for steady-state losses in framed structures, but the effect on dynamic behaviour has generally been neglected. The assumption of one-dimensionality is particularly grievous when it comes to ground-coupled elements, such as ground-bearing floors and basement walls.



Heat loss through a floor calculated using dynamic thermal network (DTN) modelling



Visualisation of flow in a naturally-ventilated hospital ward calculated in real time using the parallel processing power of a graphics card GPU

The assumption that the air in rooms is well mixed is equivalent to assuming a single temperature represents the state of the room air. This may be reasonable in the case of mechanically ventilated rooms with conventional air-distribution systems but, in naturally ventilated and displacement-ventilated rooms, this is a poor assumption. In deep-plan spaces and taller spaces it also becomes questionable.

Most building fabric materials are porous, and nearly all allow the transmission and storage of moisture. Although there have been advances in the modelling of the effects of combined heat and moisture transfer, in simulation they are often ignored and cannot be represented in many tools.

As there is increasing interest in the benefits of breathable fabrics – and in the application of constructions such as straw-bale panels – then surely the question of modelling dynamic moisture transport deserves further examination? Given the limitations arising from making these sorts of assumptions, we might also ask: can we do better? I will point out two developments in modelling airflow and three-dimensional conduction that are promising.

Eva-Lotta Wentzel and Johan Claesson, working at Chalmers University, Sweden, have demonstrated a new approach to calculating multidimensional conduction heat transfer[2]. Their dynamic thermal network (DTN) method can address the complexities of corners, junctions and ground-coupled constructions with high accuracy, but with little calculation speed penalty[3].

A new approach to modelling room airflow has emerged; this uses a different form of fluid equations – and a different mode of computing – from conventional computational fluid dynamics (CFD). It combines the Lattice Boltzmann Method for solving the fluid flow equations, and makes use of the parallel processing power of graphics processing units available with modern graphics cards[4]. This approach has the advantage of both requiring very simple meshing procedures, and being able to simulate flow in real time or faster.

Using more sophisticated models often means the user has to provide more parameter or geometric data. This potential obstacle could be avoided by making the best use of building information modelling (BIM) to encapsulate the required data. Using BIM technology, along with robust automated meshing methods, could be a key enabler of these new modelling methods.

Given that nearly all buildings are unique – and occupants' behaviour is very variable – we will always have to face up to significant uncertainties in trying to predict performance. As we place increasing reliance on simulation outputs and invest in software development, it is important that advancing the modelling of building physical processes does not get neglected. **CJ**

- This article is a summary of an editorial, appearing in the March issue of the technical journal *Building Services Engineering Research and Technology (BSERT)*, written by Dr Simon Rees, chair of the editorial board. Dr Rees is an associate professor of building physics in the School of Civil Engineering at the University of Leeds. He has been an EnergyPlus software developer, a member of ASHRAE's Standard 140 committee, and has carried out energy assessments on buildings such as One Angel Square, Manchester. He is also a co-author of CIBSE publication AM11 *Building Performance Modelling 2015*.
- BSERT is available free to CIBSE members at **www.cibse.org**, where the full editorial can be downloaded.

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PEACE OF MIND

CIBSE has published a new version of its guidance covering noise and vibration in building services. The Guide B4 steering committee and its chair, **Bob Peters**, summarise the contents, focusing on chillers and noise from waterflow systems

Sound equipment measuring drainage noise from behind a wall at Geberit's Switzerland acoustics lab

Last year, CIBSE updated its guide covering noise and vibration control for building systems. The document, known as CIBSE Guide B4, offers advice on the generation, prediction, assessment and control of noise and vibration from building services. It aims to ensure designers produce systems that meet acceptable noise limits and the requirements of aerodynamics, energy use and economics.

The guide summarises some of the main problems that can arise from heating, ventilation and air conditioning (HVAC) systems, and gives an overview of the frequency characteristics of the main noise sources, before describing the various sound transmission paths to receivers and how they may be controlled. This is followed by a detailed description of the various noise sources arising from building services provision: fans; variable air volume (VAV) systems; grilles and diffusers; roof-top units; fan coil units; chillers, compressors and condensers; pumps, motors and standby generators; boilers; chilled ceilings (active and passive); cooling towers; and lifts and escalators.

Detailed information about noise-emission data – enabling typical values of sound pressure and sound power levels to be estimated – is given in this section. This information will be of use to the designer in the early stages of design, before manufacturers' test-based data is used in the final design stage.

There are further sections on:

- Noise control in plantrooms
- Mechanisms of airflow-generated – or regenerated – noise in ducts
- Prediction and control of noise transmission in ducts and fittings
- Predicting and controlling sound levels in rooms, and the effects on speech interference and privacy
- Noise transmission to/from outside in naturally ventilated buildings
- Criteria for the assessment of noise in building services systems
- Worked examples of the prediction of noise levels within rooms and at external receptors
- Fundamentals of vibration, vibration control and practical aspects of vibration isolation.

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ULTRA LOW-SOUND CHILLERS

Cool-Therm has supplied an ultra low-sound, 1.8MW air conditioning package for a Westminster Berkeley Homes residential apartment development. It worked with M&E contractor Briggs and Forrester on a new design for the Turbomiser chillers to achieve the space and sound goals for Cleland House and Abell House.

Aecom's sound specification required a limit of 51dBA at 10m. In standard format, the chillers were rated at 63dBA at 10m. To achieve the 12dBA reduction, the design had to be re-engineered, and acoustic attenuation towers were added to both sides of each condenser fan, making an upper array of 16 towers per chiller. Measuring 1.6m high and 1m in diameter, each tower is lined with lead-damping material and a perforated liner to absorb sound. The condenser fan is positioned at the midpoint, providing attenuation at both the air inlet and discharge sides.

A bull-nosed column in the tower further reduces turbulence, while sickle-bladed, low-noise fans help streamline airflow. The compressors are housed in acoustic enclosures, reducing sound from this source by 6-7dBA. Finally, refrigerant discharge lines from compressors to condenser are lined with lead insulation, further reducing vibration.

Acoustic attenuation towers being installed for Berkeley Homes

Noise from waterflow systems

Although much of the CIBSE guide deals with noise from HVAC systems, section 4.3.19 addresses noise from waterflow systems, including all water-supply and wastewater systems.

Pipework and components in waterflow systems radiate airborne noise, which must be considered. However, noise can also be radiated by building elements – for example walls and floors – because these services are structurally attached to them.

This applies not only to appliances, such as pumps and cisterns, but also to pipework. So the type of pipework can be important, as can considering whether equipment appliances and pipework should be isolated from the building structure. Noise in waterflow systems may be minimised by: good choice of equipment and pipework; careful installation to ensure smooth water flow; avoidance of excessive flow velocities; isolation to prevent excitation of the building structure; and good equipment maintenance (see panel, 'Minimising noise in waterflow systems').

> "To reduce noise throughout sanitary systems, the important thing is to study every aspect of the noise chain"

Noise from chillers

Chillers produce tonal and broadband noise. The evaporator and condenser elements of chillers usually display different acoustic characteristics. Noise from the evaporator is often composed of tonal noise, typical of that from rotating or reciprocating machinery, linked to the rotational frequency. Broadband noise is also present, generated by either liquid or gas-fluid flow. The tonal noise tends to be dominant – perceived as a whine or whirr – but the frequency range depends on the mode of operation.

Noise from the condenser is usually broadband and dominated by fan noise, although variable-speed fans do much to control the impact of this when the equipment is not operating at full load.

Air-cooled chillers combine these sources in a single unit, enabling bespoke noise-control packages of different sizes to be considered, depending on the acoustic attenuation required. Locating the evaporator in a plantroom will remove this external noise source and, usually, reduce the noise emission from the chiller's external elements.

Guide B4 gives example noise levels from different types of chillers, although use of manufacturers' noise-level data – based on standard test procedures – is always preferred.

The document concludes with a summary of the guidance on noise and vibration, eight appendices, a glossary of terms, and a list of reference material. **CJ**

BOB PETERS is principal consultant at Applied Acoustic Design and chair of the Guide B4 steering committee

Guide B is available to download at **www.cibse.org/knowledge**

MINIMISING NOISE IN WATERFLOW SYSTEMS

The best way to reduce structure-borne noise is to stop vibrations from occurring in the first place, through holistic design and using 'quiet' appliances and pipework.

Jonathan Briafield, Geberit's product manager for piping systems, says building acoustics has to be considered at the design stage to ensure bathrooms are located above other bathrooms or kitchens, rather than bedrooms and other noise-sensitive areas.

It is also critical to consider the location of appliances within the installation room. Wall-mounted toilets and washbasins are more acoustically beneficial than floor-standing equivalents because their frames are fixed to the structure of the building, while noise-reducing studs can further minimise noise transmission into the frame.

A rubber or foam seal between the toilet and wall can also reduce the transmission of vibrations from a flush or a dropped toilet seat.

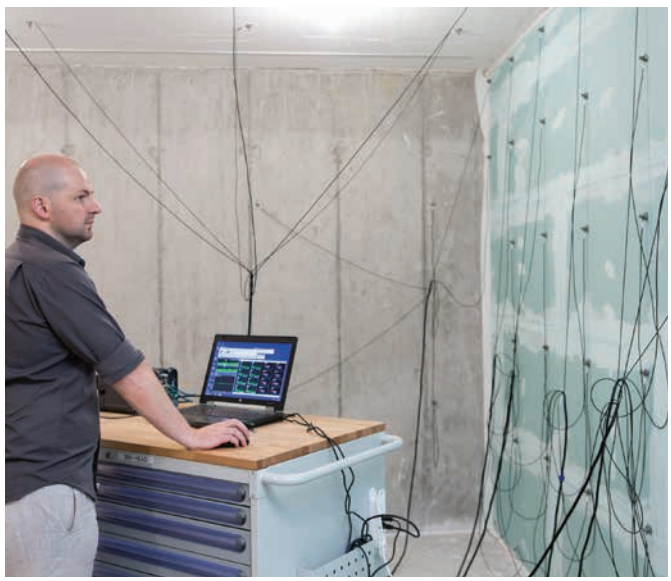
Pipe materials should be considered too. Cast iron is best at reducing airborne noise, and many 'silent' pipes have made their way onto the market, says Briafield.

'But cast iron pipes are very expensive, have a big environmental impact in production, and the rigid bracketing that fixes them to buildings can also transmit vibration into the structure,' he adds.

Where vertical stacks are impossible, designers should minimise pipe offset angles – where noise is amplified – as well as use rubber-buffering and rubber-lined bracketry on pipes to alleviate vibration transmission.

'To reduce noise throughout sanitary systems, the important thing is to study every aspect of the "noise chain" and reduce sound all the way through,' says Briafield.

He adds that if designers use all of the above mechanisms, they can get noise levels down to 25dB in bedrooms – which is much lower than the UK benchmark level of 45dB in living rooms.



Acoustic measurements are taken using acceleration sensors at Geberit's laboratory

SOUNDING THE ALARM ON OVERHEATING

Residents in new apartments are overheating because external noise is deterring them from opening windows. Max Fordham's **Anthony Chilton** says designers must account for the acoustic impact of busy roads and railway lines when mitigating overheating

Overheating is a serious issue for UK housing. The move towards better insulated, airtight buildings – plus increasing external temperatures – are part of the cause. But another significant factor is noise, particularly in urban areas.

The most common provision for mitigating overheating is opening windows. However, where external noise levels are so high that opening windows is not desirable, the occupants are left with no viable means to control summertime temperatures. In this scenario, noise – indirectly – becomes the cause of overheating.

Zero Carbon Hub's *Next steps in defining overheating* makes reference to 'unacceptably high' noise levels with open windows, but no quantitative guidance exists on what constitutes 'unacceptable'. The absence of suitable regulation means housing can pose a public health risk that has yet to be fully quantified. One example is Woods House – part of the Grosvenor Waterside development – completed in 2009 next to Victoria Station train line in London. It has been reported by both *Inside Housing* and the BBC that the flats have an overheating problem. The design intention was to allow for cooling by opening windows, but residents report 'unbearable' levels of noise from trains when the windows are open.

In 2016, the Association of Noise Consultants (ANC) assembled a working group to detail relevant guidance on acoustic conditions. Due to be published later this year, the design guide will consider noise in relation to the provision of ventilation and prevention of overheating. The challenge for the working group has been suggesting and justifying what can be considered acceptable internal noise levels when windows are open.

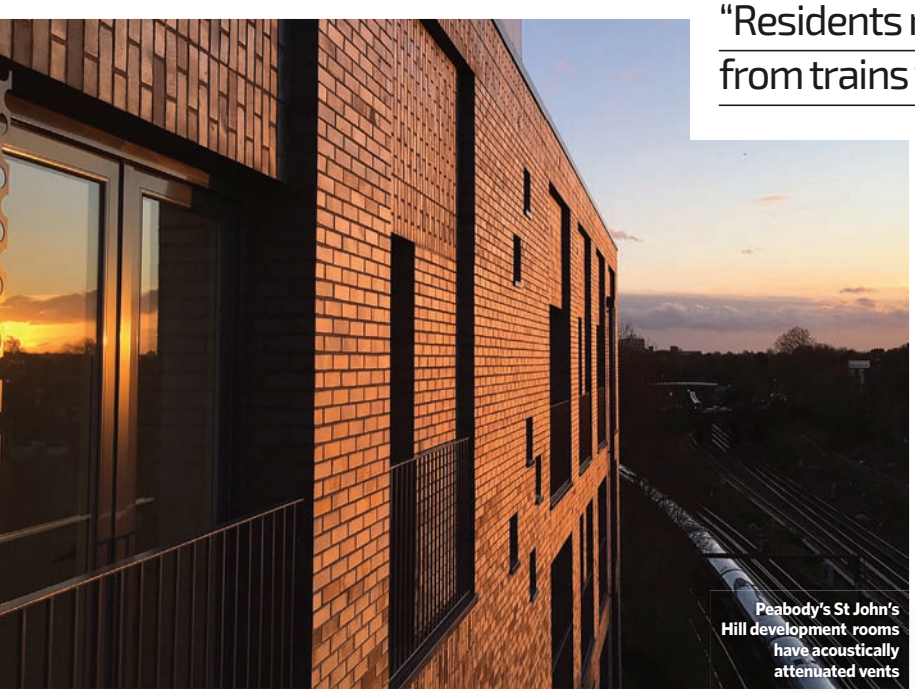
One option is to assume that the same internal noise levels – as recommended by British Standard BS8233 – should be achieved whether the windows are open or shut. However, this is an onerous requirement in practice and would often mean the use of expensive and energy-intensive mechanical ventilation and cooling solutions.

The degree to which occupants accept an increase in noise levels may depend on for what proportion of the year windows need to be open to prevent overheating.

No specific research on the interdependence of acoustic and thermal comfort exists. Instead, the guidance has been developed by considering the effect of noise on speech intelligibility during the day and on sleep during the night. More research is needed to improve the understanding of noise effects in relation to overheating control.

The ANC guidance will include case studies focused on achieving appropriate internal noise levels while ensuring overheating control. One option is to use acoustically attenuated passive façade vents to allow higher ventilation rates without admitting excessive noise. This approach was adopted at Peabody's St John's Hill development, which is exposed to high façade noise levels from the train line at Clapham Junction. Bedrooms and living rooms are equipped with acoustically attenuated vents. These provide a ventilation area of around 0.4m² in the bedrooms, while achieving sound insulation up to 15dB higher than would be achieved by an equivalent window.

> "Residents report unbearable levels of noise from trains when the windows are open"



Peabody's St John's Hill development rooms have acoustically attenuated vents

This type of passive design could be used on all but the noisiest sites or those with air-quality concerns. No technical reason exists for why it couldn't be available to housebuilders as an off-the-shelf, fully integrated approach. If overheating and noise control standards can be driven by regulation, this design type would become more common and cost-effective.

Overheating and noise requirements for residential developments need to be considered together to achieve effective solutions. We should also highlight the risks of ignoring this issue – reputational damage for developers and adverse health and wellbeing effects for occupants. CJ

HEARING IS BELIEVING

Virtual-reality technology is allowing designers to model sound in an immersive 3D environment. **Liza Young** discovers the evolution of acoustic simulation

Describing the acoustics of a concert hall or lecture theatre to clients used to be an arduous task, involving charts, plots and explaining numerical parameters. Today, it has become an aural – even visual – experience; consultants can demonstrate many types of room acoustics via simulation and, while a piece of music is playing, flick between venues to hear the subtle differences in the sound.

Since launching its SoundLab almost 20 years ago, Arup has used the technology to simulate room acoustics, allowing clients to hear and compare sound at different points of a hall or theatre. Cundall, meanwhile, has added another dimension to sound modelling – 3D graphics – after the introduction of its Virtual Acoustic Reality (VAR) last year.

By combining a virtual reality (VR) headset with a gaming engine and audio files, Cundall takes clients on an immersive audio and visual tour of a building before it is built. Being able to hear how sound changes as they move through different spaces ensures decisions – for example, on internal finishes – are based on experiential factors, rather than numbers on a page.

SoundLab

Arup created its SoundLab in the early 2000s and now has 11 worldwide. The tool allows consultants to 'listen' to buildings before they are built, and dispense with technical jargon and complex reports. The process, called auralisation, is the acoustic equivalent of a visual rendering in architecture.

As well as performing-arts spaces, SoundLab is used to demonstrate acoustic conditions in schools, offices and residential buildings; for determining glazing configurations; in railway stations – for example, to test announcement systems' clarity; and for demonstrating environmental noise from infrastructure systems, such as high-speed rail, aviation and highways.

11

The number of SoundLabs Arup now has since launching its first in the early 2000s

Stormen Concert Hall in Arup's SoundLab

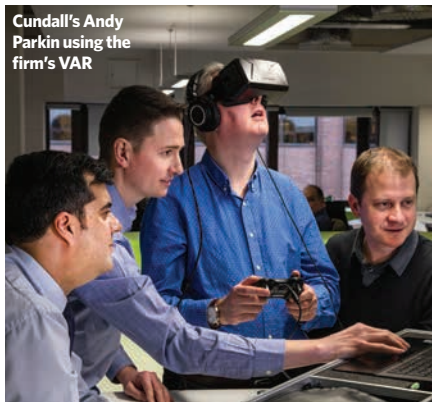
For room acoustics in an existing space, consultants visit the space and measure the impulse response. This is the reaction of the room to an impulse, such as a balloon bursting, a handclap or – more commonly – electronic signals generated by loudspeakers. The recording of the response creates a unique fingerprint for a specific space that is driven by: the geometry of the room; the relationship between the source and the receiver; and the room materials.

Ned Crowe, senior engineer at Arup, says: 'The first sound that travels from the source to the receiver is the direct sound and – shortly after – you'll have a reflection of the sound from the floor, walls and ceiling all arriving at different times, different intensities and from different directions.'

Next comes a process of convolution, which combines the impulse response with an anechoic recording – a 'dry' sound recorded in the absence of any reflections. The resulting sound can be played back in the SoundLab – an array of loudspeakers, set out in a sphere around the listening position, that reproduces the exact timing, strength and direction of the reflections as you would experience them in the room. 'You get to listen to what that anechoic recording would sound like inside that particular room,' says Crowe.

Any aspect of the performance-space design – its shape, form, geometry or materials – can be modified, while the receiver can be moved to the stalls, balcony or box, allowing the client to listen to the acoustic differences at any musician or audience location.

'The real value in the SoundLab is that it allows the client to listen to the differences,' says Crowe. 'We tend to develop a number of options so that if, for example, there is a discussion about cost associated with the height of the ceiling, we could model both options and allow the client to make an informed decision about what the differences would be.'


Cundall's Andy Parkin using the firm's VAR

Virtual acoustic reality

Cundall has taken its acoustic modelling a step further by adding 3D graphics. Its VAR technology links graphics program Unity with an Oculus Rift VR headset and CATT Acoustic software, allowing clients to immerse themselves fully within a virtual model. Here, they can walk around the building and listen to the audio signal change.

Synchronicity is the key to its success, says Andy Parkin, head of global acoustics at Cundall. 'If any aspect is out of sync, the whole experience is ruined, because any lag between the user moving their head and the image moving can create motion sickness.'

Cundall VAR maps out the virtual space with a grid of auralisations – so, as the user passes through the space, they go through different auralisation zones. Using an Xbox controller to navigate around a 3D representation of the building, the operator can listen to how the space sounds relative to their location, and assess sound clarity and the reverberation effects.

Although current computing power does not allow instant calculation of new scenarios, the virtual environments and acoustic models are pre-programmed, so comparative scenarios can be run.

Parkin says the technology has been most useful in the design of lecture theatres, because it lets consultants manipulate internal finishes and 'value engineer': 'While a teacher is talking at the front, you can walk around and ensure the expensive acoustic finishes are applied only in the learning spaces, rather than in the periphery and non-learning areas, where clarity is not an issue,' he says.

It also works the other way round. 'If the finishes in the architect's model do not work, we would be able to justify to the client why they need to spend more money on acoustic treatments,' says Parkin.

Future trends

Oculus Rift now allows multiple sound sources to be projected into the model. 'That's taken it beyond a lecture-theatre scenario and into a retail mall or open-plan office, where you can model speech privacy and the distraction efficiency of surrounding speech,' says Parkin.

Cundall's latest project, for the Retail Expo in Olympia in May, involves modelling sound in two shopping mall atria – one with hard finishes and the other with acoustic treatment – allowing users to walk between them and assess sound-quality changes and acoustic comfort.

Parkin says: 'Retail developers are taking sound a lot more seriously because, in a retail environment, it's all about the time people spend in the space. There is the realisation that if we can make retail environments more pleasant, people will stay longer and are likely to spend more money.'

STORMEN CONCERT HALL

The client required the Stormen Concert Hall in Bordø, Norway, also to be used for theatrical performances. This was a challenge for Arup because theatres and concert halls have very different demands when it comes to room acoustics and the way they operate.

To give fullness to the music, a concert hall requires a reasonably long reverberation time – the time taken for a sound to decay by 60dB. However, a theatre must have a much 'drier' room acoustic so the audience can understand the performers.

Ned Crowe says: 'We had an innovative system that involved large hinged panels, flown reflectors [suspended above the stage] and tracked panels, which could convert the space from a concert hall to a theatre. The SoundLab helped us demonstrate the differences between the two modes.'

'It's about balancing the clarity against the reverberance of the sound,' he adds. 'For spaces used for speech, you need more clarity than reverberance; in music spaces, you need both clarity – to hear the detail of the music – and reverberance, to give fullness to the sound.'

He adds: 'People are getting the fact that, by spending money on the initial design, the return on investment can stack manyfold.'

Cundall is looking at VR in several contexts, including ways the auditory experience can be combined with more information from other design disciplines. 'There are many different types of modelling software – Revit for building services and Dialux for lighting; what we're trying to find is a common platform that can link all of these models together, until we have realised a fully immersive space.'

Parkin says VR companies, games designers and manufacturers are all working on the missing link and trying to reach a solution from different angles. 'At some point we will have that 'eureka' moment.' CJ

> "Using an Xbox controller to navigate around a 3D building, the operator can listen to how the space sounds relative to their location"


Cundall used VAR to value engineer acoustic finishes at a University of Birmingham lecture theatre

PACKING A PUNCH

New battery technology could revolutionise the HVAC industry, says Klima-Therm's **Tim Mitchell**, who explains how battery chillers that integrate and control multiple power sources deliver low-cost, efficient cooling

Battery-powered building services plant is now a reality and is set to grow

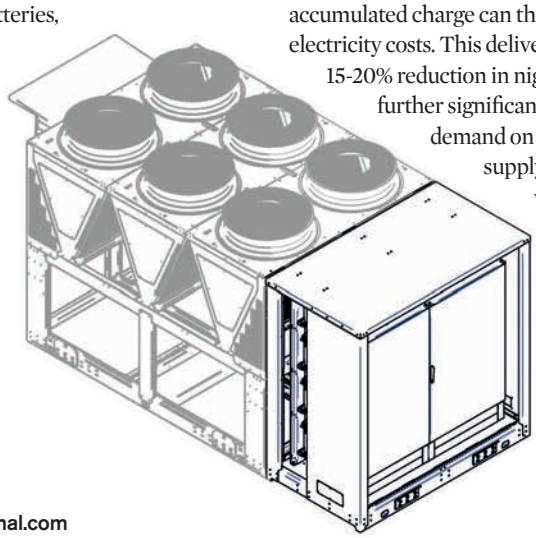
New battery technology is transforming the global car industry. By packing an unprecedented amount of energy into an increasingly compact space and lightweight structure – at an affordable cost – pioneers such as Tesla are making batteries a viable alternative to fossil fuels.

The same properties also make batteries suitable for the powering and controlling of HVAC plant. By integrating advanced battery technology with renewable energy sources and mains power, plant performance can be optimised to increase efficiency and lower running costs.

Some fleet-of-foot pioneers are already working on practical applications. Italian company Geoclima, for example, has developed the Teslamiser, a power supply management system – initially designed for use with chillers – based on Turbocor variable-speed, magnetic-bearing compressor technology. There is no reason, in principle, why the approach cannot be used with any chiller or HVAC system.

At its heart is a compact power pack, based on the latest lithium-polymer batteries, with a converter that controls charge and discharge of power to the chiller. The module can be mounted as an integral part of the chiller or installed remotely and then connected to the unit.

Under the control of an intelligent power management system, the technology automatically optimises energy flows into, within and out of the system, including managing the respective power inputs from the mains electrical supply and renewable sources – such as photovoltaic (PV) panels and wind energy – according to pre-set criteria. This enables the system to harness the preferred energy source at any given time to power the chiller, with the battery pack providing the buffer. The power source selection could be based on the lowest cost or lowest carbon – or even the most profitable– as some energy providers are now paying customers to consume energy at certain times.



A schematic of Geoclima's Teslamiser

Working on a principle similar to night-storage heaters that make use of off-peak electricity, the chiller batteries can be charged at night, when tariffs are lowest or the greenest electricity is available. The accumulated charge can then be used during the day, avoiding peak electricity costs. This delivers significant savings, given the typical 15-20% reduction in night-time energy costs. However, there are further significant savings to be made by limiting peak-power demand on site, using the batteries to augment mains supply and renewable inputs to keep peak power within a predetermined limit.

This approach, known as peak lopping or demand side response, is becoming increasingly attractive for two reasons. First, the closure of older, more polluting power stations – to comply with European carbon-reduction and clean-air targets – is putting pressure on the availability of peak-time energy supply; second, the

continuing rollout of so-called smart metering will result in costs for peak power being driven higher – much more than costs for off-peak power are reduced.

The standard modules are designed to be connected to a single Turbocor compressor unit. Each battery can store a total of around 73kWh of energy, divided into four modules and connected in series. The modules can be scaled up according to requirements, with several packs linked to an appropriate converter/inverter, suitably rated to manage the total energy.

An internal control system on the battery modules monitors the power status continually and optimises the operation of the converter/inverter. This works in tandem with a stainless-steel box to manage the battery environment, to preserve and extend the life of the battery rack.

> "There are possibilities for including intelligent recovery of energy from the chiller to charge the batteries"

Remarkably, the energy efficiency of the overall system is close to 96%, because of the effectiveness of the charge and discharge procedure, and the inherent efficiency of the inbuilt inverter.

An essential aspect of the approach is the close integration of the chiller, battery pack, renewable energy inputs and mains supply. Geoclima's custom algorithms are designed to make the most of free energy from renewable – or even profitable – sources and low-cost energy from the batteries, and to manage the mix of mains supply, battery augmentation and renewable inputs, to deliver the optimum chiller performance for the lowest possible cost.

A further advantage of the system is that it can operate as an uninterruptible power supply (UPS), maintaining plant operation in the event of a power cut for long enough to restore normal operating conditions. UPS comes as standard, rather than as an expensive add-on, providing a high level of resilience that may previously have been out of reach for many installations.

There are exciting possibilities for extending the capabilities of these technologies, to include intelligent recovery of energy directly from the chiller to charge the batteries. This would create a total energy system that optimises power from all sources – mains, renewable and self-generated – for even greater efficiency.

Photovoltaics are another part of the equation. PV-powered centrifugal chillers and variable refrigerant flow (VRF) systems are now available – for example, from Gree. One of the major attractions of PV is that, as well as providing low-cost, low-carbon energy for powering plant, there is potential for earning revenue from unneeded electricity returned to the grid.

We are working to bring together the best-available PV technology with the latest lithium battery systems and world-leading chillers, integrated under the management of an advanced intelligent control system. In future, we believe all HVAC systems will be designed and built as total energy systems. From thermodynamic, economic and environmental perspectives, it is the only rational way to go. CJ

TIM MITCHELL is a sales director at Klima-Therm. For more information visit **www.klima-therm.co.uk**

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LIFE-SAVING COOLING

Vaccine storage in developing countries is now safer thanks to new tech, say Sirach's **Metkel Yebiyo** and **Graeme Maidment**

Large areas of many developing countries have no grid electricity. According to the International Energy Agency's *World Energy Outlook (2015)* report, 1.2 billion people lacked access to electricity in 2013. More than 95% live in rural areas, mainly in sub-Saharan Africa and developing Asia, where there is no distribution grid. Even in areas with grid power, the demand has outpaced supply, resulting in unreliable availability, insufficient for continuous refrigeration.

Sure Chill, a solar-powered cooling technology invented by Ian Tansley, harnesses a unique property of water in creating a stand-alone cold store to overcome intermittent energy supply. Traditional solar refrigerators have relied on relatively expensive battery systems, which have short lives compared to the refrigerator. But Sure Chill's technology does not require a continuous electricity source and does not rely on a battery.

It works on a simple law of nature: that water is most dense at 4°C and sinks; at any other temperature, it rises. Sure Chill has harnessed this idea by creating a refrigeration compartment that is surrounded by water. When it has power – either mains or solar direct drive – the water cools and forms ice above the compartment, leaving only water at 4°C cooling the contents. When the power is switched off, it stays cold for days as the water regulates itself at 4°C.

The technology consists of a hollow chamber with a block of ice at the top and water underneath. The ice is made using solar or intermittent power, such as unreliable grid supply. Heat from inside the chamber is extracted by warming the water in its walls; as this warmer water rises, it comes into contact with ice, cools and, on reaching 4°C, sinks to the bottom again. This unique property of water is used to create a constant temperature-chilled environment of 4°C, surrounding a refrigeration compartment (see Figure 1).

Potential applications

- The technology is used by medical practitioners to ensure vaccines are stored at safe temperatures of 2°C-8°C. It maintains a steady temperature within the refrigerators for up to 14 days, without any further power input. The technology can be adapted to other applications, such as domestic refrigeration.
- If this technology were scaled to a size suitable for agri-tech cooling solutions, it would help to keep food fresh, even in the harshest environments.
- In developed countries, the technology can tap into smart-grid systems to use energy when it's cheaper, or when demand is lower, thereby reducing pressure on the grid at peak times.

Benefits

The benefits of using the Sure Chill technology include:

- Laboratory-confirmed higher performance for several critical parameters, most importantly temperature control.
- Adequate system reliability where the World Health Organization (WHO) recommendations have been followed, and a regular maintenance and repair service has been sustained.
- Lower lifetime cost of direct-drive solar refrigeration than for alternative absorption refrigeration systems – and increasingly competitive with grid-powered systems.
- Environmental improvement over absorption refrigerators, eliminating the need to burn fossil fuels. Absorption-cycle refrigeration is fundamentally less efficient than solar or grid-electric vapour-compression refrigeration, consuming more energy to provide the same cooling.

Solar vaccine refrigerators traditionally relied on rechargeable batteries to supply power through the night. However, these were costly, unreliable and hard to replace in remote locations. The challenge set by the WHO was to develop a refrigeration method that offered consistent, safe temperatures for vaccines while operating with high ambient temperatures in locations with little or no grid power. The resultant technology could link with renewable energy technologies to offer improved performance/cost ratio.

A new generation of medical refrigerators using this technology has been launched in the past 12 months, while a new cold-chain device, currently being developed, can keep vaccines cold for more than a month without power. Sure Chill is also developing agri-tech cooling solutions, and exploring the potential for food and drink refrigeration for commercial and domestic coolers.

The technology has great potential to bring reliable refrigeration to areas of the world where this has previously been impossible. **CJ**

METKEL YEBIYO is a PhD researcher and **GRAEME MAIDMENT** is professor of air conditioning and refrigeration at London South Bank University

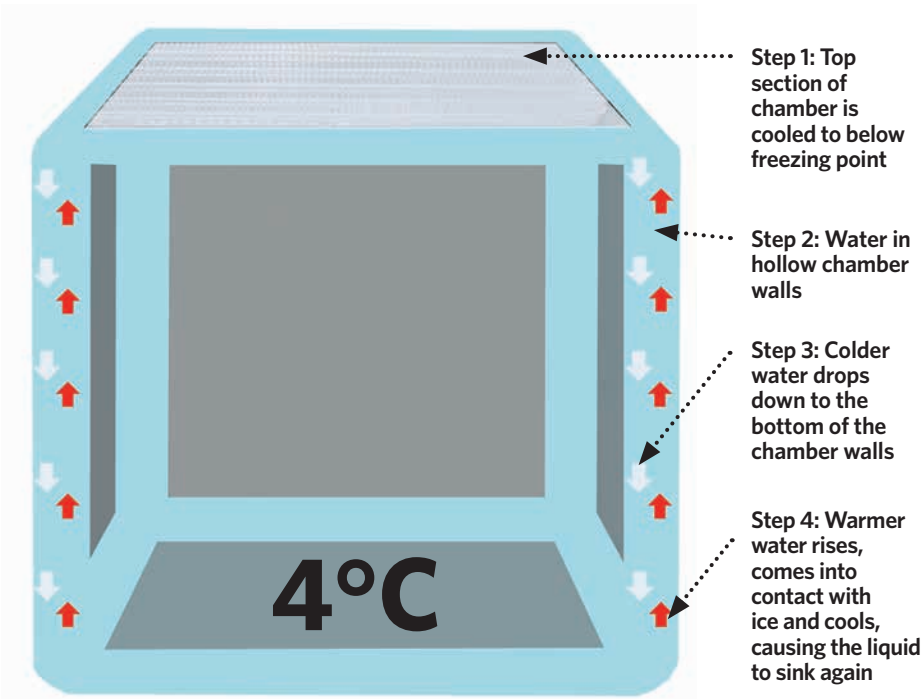

Figure 1: How Sure Chill technology ensures a steady temperature can be maintained within a refrigerator

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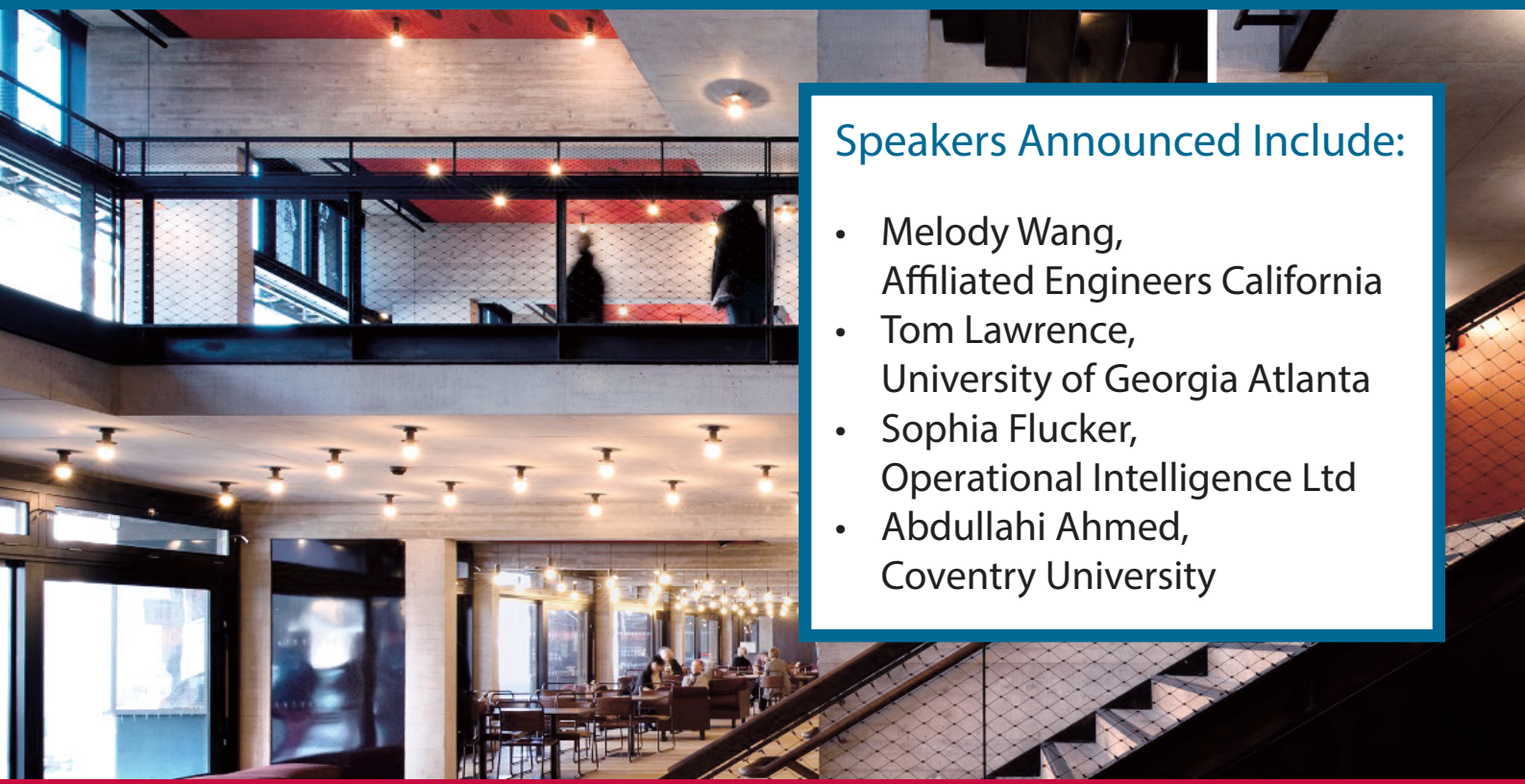

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Evaporative cooling for building environmental systems

This module considers the evaporative cooling process and its application as a low-cost means of reducing temperature in building environmental systems

Not only does evaporation drive global weather systems and reduce ambient dry-bulb temperatures, but its significant sensible cooling power has also been employed by humans for thousands of years to improve comfort. Evaporating water can provide a 'free' – or comparatively low-cost – source of cooling for buildings. This article will consider the evaporative cooling process as used in building environmental systems.

The vaporisation of water requires a significant amount of energy, whether it is for the conversion to steam in a boiling process or the more gradual evaporation from the surface of cooler water. If the water's vapour pressure is higher than the surrounding vapour pressure, some water molecules will escape as vapour from the water's surface into the adjacent space. As the vapour pressure builds in the adjacent space (with the rising number of water molecules), increased numbers of molecules will also re-enter the water surface. If the vapour pressure in the adjacent space reaches the same value as that of the liquid water, an equilibrium will be reached, with no net evaporation from the water's surface. At this point, the surrounding space – normally air – is said to be saturated with water vapour and it will have reached its 'dew point'. If the temperature of the water is then increased, its energy and vapour pressure will rise, so promoting more evaporation from the liquid and moving more latent energy into the surrounding space. Evaporation will accelerate if the temperature of the surrounding unsaturated air climbs.

The energy required to evaporate water is dependent on the water temperature. As a body of water increases in temperature, the 'latent heat of evaporation' will reduce slightly, as the internal energy of the molecules rises with increased temperature. The latent heat of evaporation is typically taken as 2,450kJ/kg at temperatures used in building environmental applications. This compares with a water specific heat capacity of only 4.18kJ/kgK – the heat needed to increase 1kg of liquid water by 1K. Evaporation reduces the total energy in the remaining water, so potentially cooling it. If the temperature of the adjacent air is higher than that of the water, it will supply heat to the water that will, in turn, maintain or increase the water evaporation rate. The primary driving force is the difference in vapour pressure and it is the availability of heat – from the air or the water itself – that powers the transfer.

The rate of natural evaporation from the water's still surface into motionless air will be relatively slow. A thin layer above the water will soon become saturated with water vapour, and then further evaporation will rely on that water vapour, adjacent to the surface, diffusing into the larger space. However, if the air is moved – for example, blown with a fan across the surface or the water is agitated or moved – then the rate of evaporation will increase substantially. The actual rates of evaporation are complex to evaluate. There are empirical formulae that have been developed – many associated with the evaporative losses from swimming pools. (For a more technical, in-depth discussion »

CPD REFRESHER

To get the most benefit from this article, a basic understanding of psychrometry is required. For a refresher on the application of the psychrometric chart and the associated air processes, see *CIBSE Journal* CPD modules 3, 7 and 9 at www.cibsejournal.com/cpd/year/2009/

Figure 1: An atomising spray humidifier or 'air washer' (Source: CIBSE KS19)

» of evaporation rates, see the paper by Mirza Mohammed Shah *Methods for Calculation of Evaporation from Swimming Pools and Other Water Surfaces.*[1])

When water is sprayed into the air by, for example, the atomising spray in Figure 1, the multiple tiny droplets create a large combined area for evaporation and heat flow. The actual relationship of heat and mass transfer is again complex. The paper by Da Silva and others, *Building Thermal Performance Simulation with Direct Evaporative Cooling by Water Spray Vaporization*[2] provides some good background.

Assuming that there is no heat added to the water spray to power the evaporation – apart from that coming from the air and the water itself – then this is known as an 'adiabatic' process. The net vaporisation will continue as long as the air has a vapour pressure below that of the water, as shown in the psychrometric chart in Figure 2. As the vapour pressure rises, there will be an increase in the air's moisture content, g (kg/kg$_{da}$) – also known as 'humidity ratio' or 'specific humidity'.

The dry-bulb temperature of the air will reduce – compared with when the spray was initially turned on – as the sensible heat, both from the air and from the spray water, is used to provide energy, as the water molecules vaporise from the droplets. As the air moisture content rises from g_A to g_B, the dry-bulb temperature falls from θ_A to θ_B, so enabling 'evaporative cooling'. It is unlikely that the air will reach a fully saturated state at X. The effectiveness (or efficiency) of the humidification process is given by the ratio of $\frac{g_B - g_A}{g_X - g_A}$ and is affected by the velocity of the air flow, the aerosol size, and the effective wetted area, as well as the air and water temperatures and vapour pressures.

The thermodynamic characteristics of water vapour by virtue of it having a near unity value of 'Lewis' number[3], are such that at the point of saturation – when the air dry-bulb temperature is at the adiabatic saturation temperature – the thermodynamic wet-bulb temperature will equal the dry-bulb temperature. At this point, the air is said to have reached its 'dew point'. If the air dry-bulb temperature was subsequently to be reduced, condensation will occur as the molecules of water vapour return to liquid as the saturated vapour pressure is reduced.

The practical wet-bulb temperature, θ' (°C), may be measured by a psychrometer – such as the sling psychrometer in Figure 3 – and although it is unlikely to coincide exactly with the value of the thermodynamic wet-bulb temperature, it is considered sufficiently accurate for practical air conditioning assessment and control. As defined by Roger Legg[4], the measured wet-bulb temperature is simply and practically 'the temperature obtained with a thermometer whose bulb is covered with a muslin sleeve, which is kept moist with distilled/clean water, freely exposed to the air and free from radiation'. The energy required for the evaporation of the water from the wetted wick into the surrounding air (at a dry-bulb temperature θ°C) is mainly taken from the thermometer's bulb, so reducing the temperature indicated by the wet-bulb thermometer. The difference in the values of the wet-bulb temperature, compared with that of the air's dry-bulb temperature, (θ – θ') (K), is known as the 'wet-bulb depression'.

The wet-bulb temperature is useful as a means of determining the moisture content and specific enthalpy of the air, using a psychrometric chart or equation; these can then be applied to calculations, including those to determine humidification requirements and evaporative cooling potential. The air's wet-bulb temperature effectively sets the lowest dry-bulb temperature that can be approached when using evaporative cooling. So, as an example, considering external summer temperatures in London[5], the wet-bulb temperature rarely (0.04% of hours) exceeds 22°C, whereas the dry-bulb temperature exceeds 22°C for more than 13% of the time. In this specific example, evaporative cooling could potentially be applied for at least 400 of the warmest hours – that is, 13% of the hours – of the summer cooling period to produce air approaching a dry-bulb temperature of 22°C.

This can significantly reduce the required refrigeration peak capacity used for comfort cooling, as well as cut energy consumption. Any potential energy savings – or reduction in installed plant capacity – will be dependent on location and application. In more arid climates, the opportunity to use evaporative cooling is

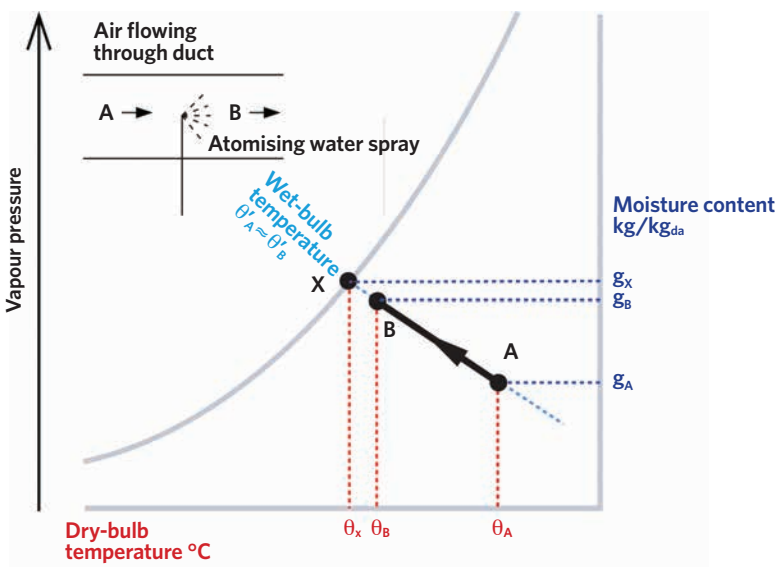

Figure 2: The adiabatic cooling process

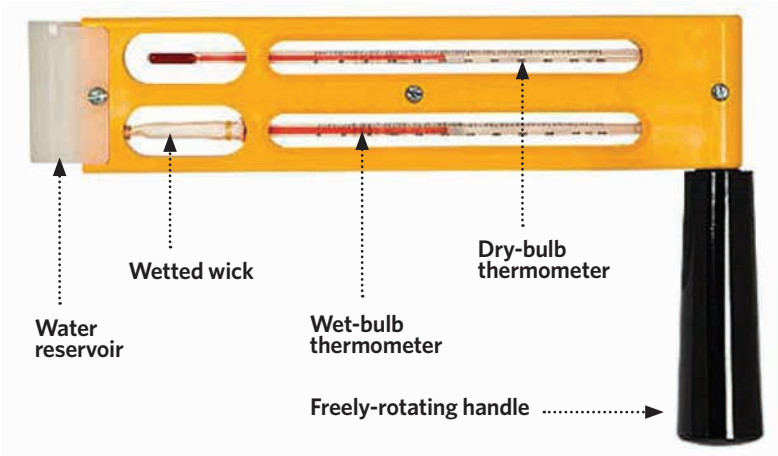

Figure 3: Sling psychrometer

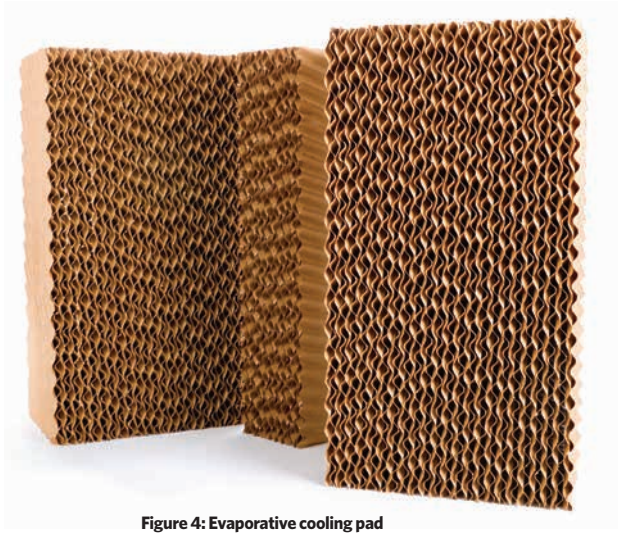

Figure 4: Evaporative cooling pad

greater but will, of course, depend on the availability of suitable water. Appropriate modelling and simulation are required to make a total life-cycle assessment of predicted performance, which should include the cost and availability of water.

If water that is sprayed into an unsaturated airstream has a higher temperature than the air dry-bulb temperature, it can both heat and humidify the air. Spray water that has a temperature below the air dry-bulb temperature but above the air dew point temperature will produce humidification and evaporative cooling. And if the water is introduced below the dew point temperature of the air, this could both cool and dehumidify the air as the water vapour in the air condenses into the cool sprayed water. (This is discussed in more detail in Legg[4], Chapter 2.)

To increase the exposed water surface area, evaporative cooling pads – such as the material shown in Figure 4 – can be used, where water is supplied through a manifold at the top of the pad and allowed to trickle down as air flows through the matrix. A traditional alternative to this was to spray the water over the (inactive) chilled water coils in the air-handling unit. Known as a 'spray coil', this process provides an increased wetted surface area compared with using a simple spray. The spray systems available today produce atomised water that can be closely controlled to ensure effective humidification, often without using an extended wetted surface.

It should be noted that the use of any recirculated water – as would have traditionally been the case in a spray coil – must be carefully considered, as doing so can create a significant opportunity for the accumulation of bacteria. The majority of evaporative coolers will use fresh water, so will present a much-reduced risk. Both freshwater and recirculated systems will also 'wash' particulate matter from the airstream, adding to the risk of organic matter accumulation. The July 2000 *ASHRAE Journal* article 'Operation and maintenance of evaporative coolers' offers a useful source of suitable operational practice.

By its very nature, direct evaporative cooling will increase the air moisture content. However, in many cases, this may not be desired.

The increase in moisture content can be mitigated in some applications either by mixing the humidified and cooled air with outdoor air that has bypassed the evaporative cooler – or by simply using recirculated room air. Another increasingly popular method is to use indirect evaporative cooling, as shown in the simplified example in Figure 5. The secondary airstream could be the return air from the conditioned space or outdoor air. The secondary air, which has been evaporatively cooled, will – through the heat exchanger – pre-cool the incoming outdoor air to reduce its dry-bulb temperature, while not directly affecting its moisture content, so also reducing its adiabatic saturation and wet-bulb temperatures. There are various arrangements that are employed to increase the potential cooling effect. For example, direct evaporative cooling could be applied to the already sensibly-cooled primary air to reduce further the dry-bulb temperature while, of course, raising its moisture content.

If evaporative cooling was to be used as the sole means of cooling in a building system, there is likely to be an increased supply air volume flow rate, compared with that when using mechanical refrigeration cooling, as supply temperatures may be higher. Evaporative cooling is often used in conjunction with a conventional refrigeration system, or together with desiccant dehumidification. This combination can provide lower supply air temperatures, as well as being able to cope with room latent cooling loads.

Turn to page 52 for references.

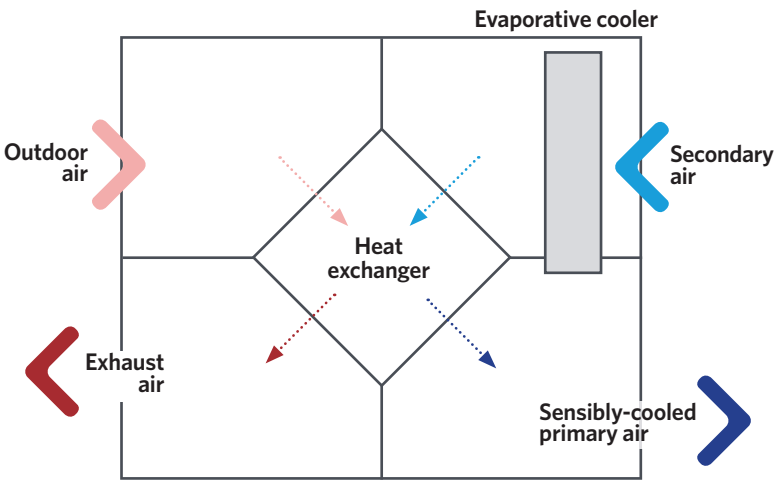

Figure 5: Schematic of a simple example of indirect evaporative cooling

» Module 109

March 2017

1. What value is typically taken as the latent heat of evaporation (kJ/kg)?

- ☐ A 1
- ☐ B 1.02
- ☐ C 4.18
- ☐ D 400
- ☐ E 2,450

2. Which of these must be true to enable net evaporation from a surface of water into the air?

- ☐ A Air dry-bulb temperature is higher than the water temperature
- ☐ B Air is not saturated with water vapour
- ☐ C Air thermodynamic wet-bulb temperature equals the practically measured wet-bulb temperature
- ☐ D Water temperature is higher than the air dry-bulb temperature
- ☐ E Water vapour pressure is lower than the vapour pressure in the air

3. In Figure 2, if g_A= 0.009 kg·kg$^{-1}_{da}$, g_B= 0.012kg·kg$^{-1}_{da}$ and g_X= 0.013 kg·kg$^{-1}_{da}$, what is the approximate humidifier effectiveness?

- ☐ A 0.25
- ☐ B 0.5
- ☐ C 0.75
- ☐ D Almost 1
- ☐ E 1.33

4. What is required for a water spray to act as an air dehumidifier?

- ☐ A Air being saturated with water vapour
- ☐ B Air dry-bulb temperature higher than the water temperature
- ☐ C The water spray being an aerosol
- ☐ D Water temperature higher than the air dry-bulb temperature
- ☐ E Water temperature lower than the air dew-point temperature

5. In the simple evaporative cooling system as shown in Figure 5, which section is most likely to have the lowest dry-bulb temperature in summer for a cooled building?

- ☐ A Air in the top-left section
- ☐ B Air in the top-right section (after the evaporative cooler)
- ☐ C Air in the top-right section (before the evaporative cooler)
- ☐ D Air in the bottom-left section
- ☐ E Air in the bottom-right section

Name (please print) .....

Job title .....

Organisation .....

Address .....

.....

.....

Postcode .....

Email .....

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Further reading:

One of the most comprehensive books that considers the theory and practice that underpin evaporative cooling in building applications is *Air humidification*, available through **www.carel.com/e-book-request**

There is some coverage in CIBSE Guide B3 2016, section 3.2.4.7 *Humidifiers* and section 3.3.3.9 *Evaporative cooling*. The CIBSE Knowledge Series KS19 *Humidification* provides a more extensive background, and ASHRAE Applications 2015 Chapter 52 *Evaporative cooling* offers some useful commentary of specific applications.

References:

1 Shah, M M, Methods for Calculation of Evaporation from Swimming Pools and Other Water Surfaces, *ASHRAE Transactions*, Volume 120, Part 2, 2014.

2 Da Silva, A C S B et al, Building Thermal Performance Simulation with Direct Evaporative Cooling by Water Spray Vaporization, *HVAC&R Research*, Volume 12(3), pp669-692, July 2006.

3 Jones, W P, *Air Conditioning Engineering*, Section 3, Routledge, 2000.

4 Legg, R C, *Air Conditioning Systems: Design and Integration*, Chapter 1, Batsford, 1991.

5 CIBSE Guide A 2015, table A2.9g.

Woodland in a box

TITON WHOLE HOUSE VENTILATION SYSTEMS

With people spending 90% of their time indoors, ensuring good internal air quality is crucial... just look at these breath-taking stats:

consume
893kg of O_2
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10x

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283,900kg of O_2
per year

equivalent
14 acres

Clean air dependent on filters used within unit, for expert advice please contact Titon

CLEAN AIR... just as nature intended

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Titon® ventilation systems

PRODUCTS & SERVICES

Simply saving energy with the programmable EasyZAPP

Danlers is pleased to announce the launch of its EasyZAPP range of PIR occupancy switches. Designed for the automatic control of lighting or other connected loads, these products are remotely set-up or adjusted using a free app on an Android phone or tablet.

The EasyZAPP range work as presence detector switches and can be adjusted for settings such as photocell override, time lag and maintained lux levels (dimmable versions only).

The phone or tablet can be used as a remote control on/off override, or to configure a number of EasyZAPP controls at the same time. The products are straightforward to install and generally make use of existing wiring, making them suitable for either retrofit or new installations.

The EasyZAPP range includes switching only controls as well as controls for dimming available for either DALI, 1-10VDC or DSI dimmable ballasts. Mounting options include: ceiling flush, ceiling surface and batten mount variants.

Call 01249 443377, email sales@danlers.co.uk or visit www.danlers.co.uk

Evaporative cooling app from Condair

Condair has developed an app that determines how much energy could be saved by using in-duct exhaust air evaporative cooling and a heat recovery system, rather than just traditional compressor-driven cooling.

Using worldwide weather data from Meteonorm, the myCoolblue app calculates how much energy is needed annually to cool a building. Taking into account worldwide data, the app projects how much cooling could be delivered each month using exhaust air evaporative cooling.

Visit www.condair.co.uk

Flexible HVAC for Jaguar Land Rover's new manufacturing plant

AET Flexible Space, provider of underfloor air conditioning systems, has completed commissioning equipment installed in the office area of the new Jaguar Land Rover manufacturing facility at the i54 Business Park in South Staffordshire. The building is part of a manufacturing expansion plan adding to the £500m engine plant on the i54 site, which was opened at the end of 2014. The latest building has been delivered by Associated Architects in partnership with Arup.

Call 01342 310 400, email lucy@flexiblespace.com or visit www.flexiblespace.com

University looks to Big Foot Systems for the right support

Big Foot Systems has supplied support solutions, including bespoke air handling unit supports, for rooftop plant at a new health and biosciences building on a university campus. The new £11.5m three-storey facility provides 5,000m^2 of teaching and research space.

Featuring state-of-the-art clinical and diagnostic equipment for health professionals and patients, the project required both air handling units and external condensers for cooling.

Call 01323 844 355 or email enquiry@bigfootsupport.com

Panasonic introduces new VRF ECOi ME2 solution

Panasonic's latest line of VRF systems, the ECOi EX series, provides a new benchmark for the heating and cooling industry, surpassing other models for environmental performance, quality and comfort.

The new Panasonic ECOi EX 7 Series ME2 VRF range is now available and includes three sizes of single outdoor units ranging from 8HP to 20HP. Boasting a flexible combination design, installers are able to combine up to 80HP.

Visit www.aircon.panasonic.eu

Dutypoint pumps power new Thames water pipeline

A large bespoke pump system designed and built by UK manufacturer Dutypoint is being used as part of Thames Water's £25m project to stop extracting water from the River Og in Wiltshire and significantly reduce abstraction from the navigable River Kennet.

Dutypoint worked alongside mechanical contractor Bridges to design and manufacture the systems needed for the project.

Dutypoint can design and manufacture pump systems to exacting requirements and is on hand throughout all phases of a project.

Visit www.dutypoint.com

Passive cooling thermal energy storage (TES)

TES is the temporary storage of thermal energy for later use, bridging the gap between energy availability and energy use.

Overnight cool energy is stored in the form of 20-27ºC phase change material-filled containers, and later used to absorb the internal and solar heat gains during daytime for an energy-free passive-cooling system. This technology offers environmentally friendly, maintenance- and energy-free cooling for new or existing buildings.

Call 01733 245511 or visit www.pcmproducts.net

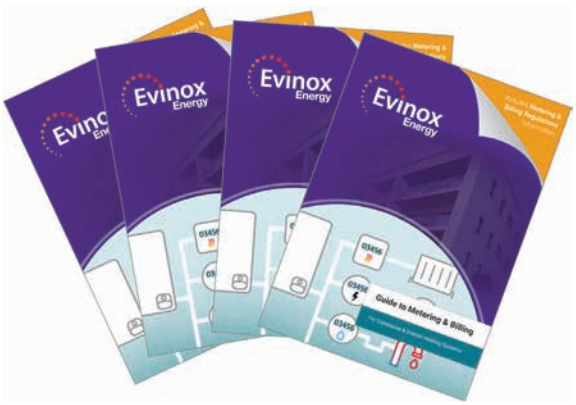
District Energy Town Square at Ecobuild

Evinox will be exhibiting in the District Energy Town Square at Ecobuild 2017, taking place from 7-9 March at ExCeL London. The exhibition will be themed as an immersive city, complete with main street, distinct destinations and special feature attractions. Ecobuild is the UK's largest event for specifiers across the built environment, from architects and developers to local government and major infrastructure clients.

Visit us at stand F231 to find out more about our latest ModuSat HIU for communal and district heating schemes, which takes just 15 seconds to reach 55°C from the tap opening. You can also pick up a copy of our new *Guide to metering and billing*, a useful document for anyone involved in a communal or district heating scheme.

Evinox Energy combines smart HIU technology with excellent after-sales end user support and flexible metering and billing services.

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

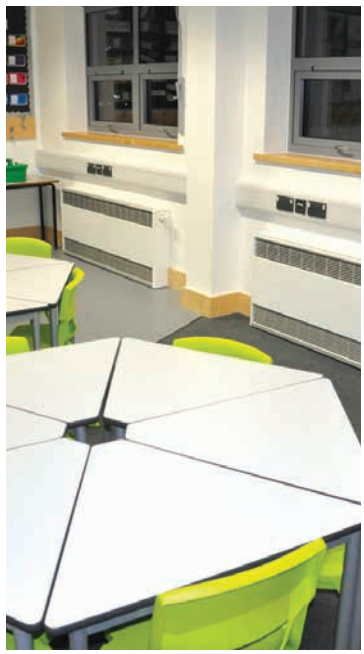


Energy saving radiators installed in new north London primary school

More than 150 high efficiency and super safe Autron low surface temperature (LST) radiators have been installed at the new Garfield Primary School, Enfield. The large primary school moved more than 500 children last summer into a new building, incorporating some of the latest energy conservation innovations, including active energy use monitoring.

Given the need for safe and efficient heating, Enfield Council specified the installation of Autron natural convector LST radiators throughout the new school. Thanks to its low water content heat emitter, an Autron natural convector radiator will typically start to deliver room heating within two minutes, compared to up to 20 minutes for conventional panel radiators. This responsiveness means the heating only needs to come on when required. The reduced need to 'buffer' heating contributes to a more comfortable learning environment and can deliver fuel cost savings. A case study is available to read at www.autron.co.uk/case-studies

Call 01952 290 498, email sales@autron.co.uk or visit www.autron.co.uk



Sentinel commercial team continues to grow

Russ Walliss (pictured) has taken on the role of commercial sector manager for the South, and is responsible for providing effective technical sales services to meet the individual needs of a range of commercial clients including specifiers, local authorities, healthcare providers and design and build contractors. Walliss will be a familiar face to many in the heating industry, having occupied senior roles in the sector for more than 35 years, including at Hamworthy Heating and Colt International.

Call 01928 704 330, email customer.services@sentinel-solutions.net or visit www.sentinelprotects.com

It's all about KNX-tions

When making connections, Geze's new IQ box KNX – an interface for IQ window drives – is a smart choice for controlling natural ventilation.

It can 'talk' to technology solutions around a building linked into a KNX building system, enabling functionality and security at the touch of a button.

The BMS central panel displays the status of automatic windows, which can be controlled and monitored within a central location.

Call 01543 443 000, email info.uk@geze.com or visit www.geze.co.uk

Introducing the Air Academy

Ventilation solutions manufacturer Airflow Developments has opened its new Air Academy at its head office in High Wycombe. The facility has been designed to showcase the benefits of effective ventilation systems in both domestic and commercial properties as well as the pioneering technology behind Airflow's product portfolio, and to educate and train attendees on best practice installation methods. The academy demonstrates Airflow's commitment to education and training. The facility benefits from fully operational ventilation with heat recovery installations.

Visit www.airflow.com or follow @AirflowD on Twitter

Geze's smart solution for building management

The increasing popularity of smart building solutions is turning touch-of-a-button premises management into a reality, and now Geze is introducing an interface module that will draw its door and window technology into that network.

The IO 420 connects into the BACnet system – the standardised global data communication system that is independent of manufacturers and specific technologies – to manage light, heating, ventilation and alarm systems.

Call 01543 443 000, email info.uk@geze.com or visit www.geze.co.uk

Hygromatik's tips for the winter months

Winter can be a difficult time to maintain buildings, particularly when it comes to humidifiers regulating healthy air for occupants.

To help prevent illnesses, it is crucial that the right humidifier is specified and installed, and that the system is properly maintained.

Since normal water is ordinarily conductive, electrode steam humidifier systems – such as Hygromatik's HyLine, CompactLine, and MiniSteam – are ideal when it comes to generating hygienically-clean steam from standard untreated tap water.

Call 02380 443127 or email info@hygromatik.co.uk

London living

The lack of of reasonably priced and suitable accommodation in London is well known. The Greater London Authority has been active in trying to assist in easing these issues and a recently completed high-rise project in Southwark is a great example of this. The building is part of the £3bn regeneration of the Elephant and Castle area, and this particular project is delivering more than 450 much-needed homes.

Supporting this development, and ensuring prompt, accurate delivery of water, are a range of Grundfos Hydro MPC-E energy efficient booster pump sets that were delivered to site on skids, ready for installation. Built at the 10,000m^2 Grundfos manufacturing plant in Sunderland, this level of offsite engineering adds value and offers customers design, build, assemble, test and distribution from under one roof.

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

Outstanding record of long service

The latest attainment of 25 years' service prompted Gilberts Blackpool to check its records. It found that, currently, almost 25% of Gilberts employees have been with the Lancashire manufacturer at least 20 years.

The company is unique in undertaking all aspects of its production in house – from design to formation of dyes to manufacture – enabling it to give clients the reassurance of quality control whether off the shelf or a bespoke design.

Call 01253 766 911 or email info@gilbertsblackpool.com

Government-backed energy saving with Stratton mk2 wall hung boiler

Hamworthy Heating's Stratton mk2 compact wall hung boiler range, launched last year, is now part of the government's Energy Technology List.

Products on the list offer financial advantages for purchasers through the government's enhanced capital allowances scheme, which was introduced to tackle climate change. It is designed to encourage businesses to invest in energy-saving equipment.

All six models of the Stratton mk2 boiler range (from 40kW up to 120kW) are eligible.

Call 01202 662 500, email sales@hamworthy-heating.com or visit www.hamworthy-heating.com

FDS Consult appoints former Hoare Lea associate engineer as London team expands

FDS Consult, an expert in fire engineering, has appointed Steven Morgan to head up its growing London-based team. He joins as associate director, from Hoare Lea, and has more than 25 years' experience in the industry.

Throughout his career as both a fire engineer and chartered building control surveyor, Morgan has given fire safety advice to designers, contractors and building operators across all sectors, including large residential, commercial and mixed-use projects. His new role at FDS Consult will involve overseeing the growing consultant team in London, offering close-at-hand expertise and advice for the company's capital-based clients.

With an increasing number of residential developments opting for open-plan layouts, there is a greater need for engineered fire strategies that offer an alternative to a standard code compliant approach.

Visit www.firedesignsolutions.com

Polypipe's professional development centre features new ventilation training facilities

Polypipe's latest Professional Development Centre, offering training across a range of Polypipe products, now includes domestic ventilation.

Equipment on display at the centre includes: energy-saving, whole-house Silavent mechanical ventilation with heat recovery and CMX mechanical extract ventilation units; Domus rigid and Radial semi-rigid duct systems; Silavent positive input ventilation; plus Silavent bathroom and kitchen fans.

Call 03443 715 523 or visit www.polypipe.com/ventilation

Swegon's new Wise takes demand control to next level

The new generation Wise system represents more than 15 years' experience and the latest pioneering technology in demand controlled ventilation.

Demand controlled ventilation saves up to 80% of the fan energy and 40% of the cooling and heating energy in a building. Swegon's clever new Wise system is able to do this without sacrificing any of the indoor climate comfort.

Wise has been developed using cutting-edge development work and experience gained from hundreds of installations. It is designed to be easy to install, flexible and user friendly, ensuring the entire building process is as efficient as possible. Software, such as Swegon early stage building optimisation (ESBO), and the product selection software IC Design, provide decision-making support.

A patented radio solution makes Wise dampers and diffusers communicate via integrated radio nodes. This means cost savings thanks to reduced cabling and it eliminates the risk of misconnections.

Visit www.swegon.co.uk

Kingspan pipe insulation installed on French Ministry of Defence

The optimum thermal performance and environmental credentials of Kingspan Kooltherm FM pipe insulation have been used to full effect at the French Ministry of Defence's new €4.2bn Paris HQ.

Known as the Hexagone Balard, the striking 16.5 hectare facility unites all the Ministry of Defence departments under one roof for the first time, enabling it to become a more collaborative and efficient organisation.

Call 01544 388 601, email info@kingspaninsulation.co.uk or visit www.kingspanindustrialinsulation.com

Light Efficient Design UK announces unique single sided retrofit LED solution for low bay and floodlight installations

The LED-8090A allows affordable and non-invasive replacement of 400W HIDs with 120W LED. Its single-sided LED design allows a high light output ratio-ensuring users benefit from clean light (>80 CRI) while saving up to 70% in energy costs and emissions.

Using the existing light fittings, installation requires bypassing the ballast or control gear and directly connecting the lamp holder to the 240V supply. The new retrofit LED lamp is then easily installed.

Call 0333 577 8133, email sales@ledukltd.com or visit www.led-llc.com

Biodiesel from waste oil powers increasing number of boiler plants

Atlantic Boilers has been supplying high efficiency super-condensing boilers, which burn B100 biodiesel, for more than 10 years. In a new document 'Green Heat 2017' Atlantic aims to answer questions around using fuel from refined waste oil. It also explains the heating and installation processes. The B100 R Series boilers have been installed in universities, housing developments and royal residences. The boilers have a Sedbuk Energy 'A' rating with efficiencies between 92% and 99% GCV.

Email technicalsales@atlanticboilers.com

New from Elco: Trigon XL – future performance, today!

Elco Heating Solutions has launched the new Trigon XL range of floor-standing gas condensing boilers.

Available in seven different models with outputs from 150-570kW, the range offers a wealth of benefits, including: ultra-low NO_x emissions complying with class 6 (2018) requirements, an 8 bar working pressure, 30k flow/return temperature differential, superb seasonal efficiencies and an ultra compact footprint.

The boiler's low NO_x emissions are achieved by using a commercially proven premix-burner system.

Visit www.elco.co.uk or follow @elco_uk on Twitter

Webercem spray DSP stabilises Scottish bank

Webercem spray DSF by Saint-Gobain Weber has been specified for the stabilisation of an earth embankment in Dunoon. DSF is a ready-to-use, polymer modified, cement-based mix containing inert limestone aggregates and dust suppressants. It contains alkali-resistant glass fibres providing good strain relief and stress distribution reducing the risk of shrinkage cracking. Designed to give high tensile strength it reduces rebound on application, minimising wastage, and controlling application thickness.

Visit www.saint-gobain.co.uk

Zumtobel number one for H1 development

A variety of LED luminaires from Zumtobel have been used as part of a major refurbishment of H1, a 200,000ft² office facility, formally known as Seafield House, in Aberdeen. The project has also incorporated emergency lighting and lighting controls from Zumtobel's vast product portfolio.

The H1 refurbishment has seen the unveiling of a new multi-function reception area with steel grey posts, wooden floors and a wooden ceiling.

Call 01388 420 042, email info.uk@zumtobelgroup.com or visit www.zumtobel.co.uk

Waterloo creates the right airflow for key biomedical research

As many as 10,000 air distribution products from Waterloo Air Products, UK manufacturers of advanced air distribution and ventilation devices, have been installed in the new Francis Crick Institute, one of Europe's leading biomedical research labs, carrying out important research on the biology underlying human health and disease.

Waterloo's products play a big part in creating the right airflow, to meet the conditions needed to carry out successful research in the state-of-the-art research laboratory in central London.

Call Amie Hill on 01622 711 500 or email enquiry@waterloo.co.uk

DIRECTORY Your guide to building services suppliers

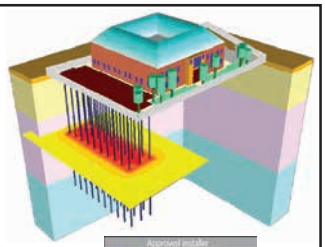
Tel: 0207 880 7633 Email: greg.lee@redactive.co.uk

Air Conditioning

Air Handling

Building Performance

Energy Efficiency



Ventilation & Air Conditioning

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Trusted recruitment advisors bringing candidates and organisations together to build outstanding careers

Senior / Associate Electrical - Nottingham
£50K plus benefits

A mid-sized building services consultancy is looking for a Senior/Associate Electrical Engineer in their Nottingham office. As a company with a culture of progression, if your career objectives are not being met by your current employer, consider this role as training and development courses are provided in order to support you in your career progression. On offer is a salary of up to £50,000 alongside benefits including; company car/allowance, pension + more.

Principal Mechanical Engineer - Manchester
£45k plus benefits

A global engineering firm is seeking a Principal Mechanical Engineer to join their 150 strong team in central Manchester. If you are lacking in responsibility then this consultancy offer you the chance to lead projects valued a £35m+ from a financial, technical and managerial point of view. You will be rewarded with a salary of up to £45,000, alongside benefits which include; car allowance, paid subscriptions, pension, healthcare and more.

Mechanical Design Engineer - Ossett
£40k plus benefits

A medium sized building services consultancy in Ossett is currently seeking a Mechanical Design Engineer to join their vibrant office after a number of recent project wins, varying from blue chip retailers, commercial offices and leisure centres. On offer is a salary of up to £40,000 alongside benefits including; pension, company bonus, free parking and more.

Associate Building Services Engineer - Hampshire
£65k plus benefits

An outstanding opportunity to join an award winning multi-discipline consultancy with national presence. As a Chartered engineer you will have proven yourself as a capable designer in either mechanical or electrical, and will be confident leading multi-discipline design teams. You will be given autonomy to develop your area of the business to its full potential and reap the rewards. This is an opportunity not to be missed!

Senior Electrical Design Engineer - Northampton
£45k plus benefits

As a consistent CIBSE award winner this client has needed to build bigger offices to fit in their expanding business. As a senior electrical engineer you will be a capable man-manager with experience in the education, commercial and residential markets. It is paramount that you have excellent working knowledge of AutoCAD, Dialux, Relux and Amtech. In return you will be joining a dynamic and high quality company.

Senior / Associate Mechanical Design Engineer - Bristol
£45k to £65k plus benefits

This is your chance to work for an internationally recognised engineering firm who have proven themselves on some of the world's most prestigious builds. This vacancy is a result of increased workload and this is your chance to join them working on projects across the UK. You will have proven yourself as a capable engineer and will, ideally, be chartered.

Associate Mechanical Design Engineer - London Bridge
£65k plus benefits + car allowance

A forward thinking medium sized firm of building services consulting engineers is currently looking to expand their team in London Bridge. With a modern and dynamic attitude to design, this new position will suit someone looking for a challenging yet rewarding role working with a very supportive team of technically first class engineers.

Intermediate Mechanical Design Engineer - City of London
£35k to £40k plus benefits

An award winning multi-disciplinary consultancy is now looking for a top intermediate mechanical design engineer to join their team in Central London. Working on projects in the UK and internationally, you will be joining a solid team offering some of the top technical building services designs available in London. As an intermediate engineer you will also be tasked with running smaller projects from concept to completion, where you will look after the time and financial criteria.

Electrical Associate - Central London
£65k plus benefits

An ambitious multi-discipline consultancy is currently seeking an enthusiastic, talented and experienced individual to join them at Associate level. Undertaking projects from major housing developments, healthcare and education work to major new settlements. You will be expected to help run the M&E team, being responsible for the management of the team and assisting with management of all building services engineers on a number of projects, ensuring the team undertake detailed design to the required standards.

Find all jobs at conradconsulting.co.uk

For more information please contact
martin@conradconsulting.co.uk

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Suffolk 01728 726 120
Leeds 0113 457 0079
Edinburgh 0131 240 1260
Manchester 0161 209 3246
Birmingham 0121 698 2085

www.fbwgroup.com

FBW is a leading East African building consultancy. We are a UK based company providing multi-disciplinary services throughout the region from our established offices in Kenya, Uganda and Rwanda.

Following a period of sustained growth we are seeking adventurous, dedicated and career-minded MEP professionals in the following positions to strengthen our senior Building Services Team and to help drive forward our next period of expansion within East Africa:

Senior Mechanical Engineer
Senior Electrical Engineer

If you have the ambition to make the change and the right qualities to make a difference in this challenging and rewarding role we would like to hear from you.

Interested? Email us outlining your background and aspirations and including a CV to: **careers@fbwgroup.com**

FBW

Full job descriptions can be found on our web site.

Senior Mechanical Consultant

Salary band: min £40k - max £49k FTE, based in Worcester

We have an exciting new opportunity for an experienced, Senior Mechanical Consultant to join our Mechanical & Electrical team at Place Partnership. Working to the Portfolio Manager M&E you will be responsible for managing a team of M&E consultants, and providing expert and technical advice on the condition, capacity, suitability and statutory compliance of mechanical installations, plant and equipment managed by Place Partnership. Based in Worcester, you will act as the Senior lead on all aspects of mechanical installations and you will manage a number of key relationships with clients, contractors and suppliers.

You will be degree qualified (or equivalent) in mechanical building services engineering and will have a proven track record in mechanical systems, feasibility, design, and providing technical expertise on maintenance strategy and improvements. You will be a member of CIBSE or the Institute of Mechanical Engineers.

We are a progressive company that is looking to expand and grow. This is a really exciting time to join Place Partnership and a fantastic opportunity for new talent to help shape and develop our business. If you are enthusiastic and passionate about mechanical engineering, and feel you can add value to our team and are keen to develop your career with Place Partnership, please send your CV with a covering letter to **Careers@Placepartnership.co.uk**

Closing date: 10th March 2017

Place PARTNERSHIP

b-a-r beeby anderson recruitment

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

Senior Electrical Engineer
London, £38k - £45K + benefits

Are you passionate about engineering and looking for a company that will support you in developing your career whilst you work with some of the UK's most established engineers and highest profile projects? We are looking for motivated individuals who have 3- 5 years' experience in design engineering and enjoy working on innovating concepts and evolving solutions to complex and interesting challenges. Ref: 4084

Senior Mechanical Engineer
North London, £45k – 55k + benefits

Excellent package offered for an aspiring Associate Director. Working on projects in the mixed use and residential sectors valued between £20 - £200m. You will be responsible for project delivery, team management, and client liaison. Must be driven and dedicated as the client is looking to grow even stronger, further cementing their excellent reputation for delivering quality every time. Ref: 4174

Senior Mechanical Engineer
Central London, £38 - £40 p/hour

International environmental design consultants and building services engineers committed to high performance and sustainable design in the built environment, founded in 1990 they now have 11 offices worldwide. The requirement is for a proactive and self-motivated Mechanical Engineer with a demonstrable track record of co-ordinating and delivering projects. This firm offers an exciting, engaging, professional and fun working environment. Ref: 4173

Senior Electrical Engineer
Central London, £38 - £40 p/hour

An award winning consultancy that is at the forefront of building high performance buildings with a focus on sustainable design; an opportunity has arisen for a Senior Electrical Engineer to join the well-established team in London. You will have the opportunity to work on some of the most iconic buildings In London that will push the boundaries of design within the built environment. Ref: 4163

Associate Mechanical Engineer
London, £55k - £70k + benefits

A rare opportunity for a forward thinking engineer with excellent team management and project delivery experience has arisen with one of the UK's leading design consultancies. They are seeking an individual who has real drive to be an integral part of the future senior management team. With a superb reputation for delivering high profile projects and multiple employer awards to their name, this is an outstanding opportunity for you to be part of. Ref: 4150

Contract Mechanical Engineer
Nottingham, £30p/h

I have a requirement for a mechanical engineer to work on a temporary contract in Nottingham. You will provide designs from conception through to completion on high end mixed use residential projects. The work is predominantly conceptual and detailed on HVAC systems as well as client liaison. This is a long-term contract with an immediate start. Ref: 3707

Thinking of your future

www.b-a-r.com

The possibilities are endless when you choose a career with us. As a large employer we have a wide range of jobs and we positively welcome applications from all sections of the community. Working from a few hours a week to full-time 37 hours, you'll enjoy the support to develop, along with some of the best benefits around, such as childcare vouchers, a final salary pension and excellent flexible working. Take a fresh look at what we can offer you.

Building Surveying and Engineering jobs in Derby

Derby City Council has numerous exciting opportunities to join a progressive, busy, service. Property Design and Maintenance provide building surveying, engineering, design and project management services for a wide range of customers including schools, leisure, museums, children's and older people homes and corporate administrative buildings.

We are improving the way we deliver our property services. To drive this improvement forwards, we are recruiting to a wide range of property design, surveying, engineering and management roles, including:

- **Building Engineering and Surveying Managers up to £62,575**
- **Project Supervisor (Mechanical/Legionella) up to £49,650**
- **Project Supervisor (Electrical) up to £49,650**
- **Services Engineering Team Leader up to £54,367**
- **Principal Services Engineer (Maintenance) up to £49,650**
- **Engineering Supervisor – up to £44,920**

All of the roles above include a Market Rate Supplement

- **Principal Compliance Engineer (Mechanical) £31,288 - £35,093**
- **Senior Electrical Engineer (Maintenance) £28,203 - £30,480**
- **Senior Maintenance Engineers £28,203 - £30,480**

As a valued employee of the council there are many benefits you will get on top of your salary. That's why many people stay working for Derby City for long periods of their working lives. We offer the opportunity to work flexibly to support a greater work life balance. You will also receive a competitive annual leave entitlement, membership of an attractive pension scheme and access to the employee benefit scheme where you can access savings on a wide range of products and services.

About us

From a growing range of leisure and recreational facilities to the historic Cathedral Quarter, our city is full of opportunities for exploration and adventure.

Living in and around Derby is affordable too with competitive prices and tremendous choice ranging from modern riverside apartments to countryside cottages.

We also have a number of top schools, a top 5 further Education College and a growing modern University – one of the eight in the East Midlands.

The critically acclaimed Derby Theatre, Derby LIVE performance programme, QUAD Art and Film centre, QUAD brings the very best in international quality art and film, Deda – the regional dance centre, a centre for excellence in the world of dance performances, classes and visual art. Derby and Jazz and Sinfonia ViVa, the East Midlands regional orchestra, are all based in the city.

The City's position and access to the wider motorway network means that the conurbations of Nottingham, Leicester, Sheffield and Birmingham are readily accessible in less than an hour with the business centre of Leeds, Manchester and Liverpool a little over 90 minutes away.

www.visitderby.co.uk/

www.derby-guide.co.uk/

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To apply please submit a CV and a supporting statement (no more than 2 pages) via e-mail to: recruitment.team@derby.gov.uk

We will be reviewing and arranging interviews as and when CV's come in.

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PROUD OF DERBY

DERBY CITY COUNCIL

EVENTS

HIGHLIGHTS

Munish Datta, M&S
Ecobuild, 7-9 March

Roger Sexton, Xicato
LED lighting technology, 8 March

INTERNATIONAL AND NATIONAL EVENTS/ CONFERENCES

EcoBuild
7-9 March, ExCeL London
Annual conference and exhibition. Come and visit CIBSE on stand C191 at the heart of the exhibition. CIBSE will be hosting a membership workshop and showcasing our latest projects.
www.ecobuild.co.uk

BIM Roadshows
8 March, Belfast
10 March, Dublin
15 March, Cardiff
Presenters will use a project case study to demonstrate the real-world application of digital technologies and workflows. Tour dates continue to May.

CPD/MCC TRAINING

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

Electrical services explained
7-9 March, Manchester

Energy efficient building regulations: Part L
8 March, Manchester

Sanitary and rainwater design
8 March, London

Electrical distribution design
9 March, London

Practical project management
9 March, London

High voltage (11kV) distribution and protection
10 March, London

Gas safety regulations
10 March, London

Electrical services explained
14-16 March, London

Energy strategy reports
16 March, London

Introduction to heat networks code of practice
22 March, London

Design of heating and chilled water pipe systems
24 March, London

Understanding psychrometric charts
24 March, London

Mechanical services explained
28-30 March, London

Building drainage explained
19 April, London

Practical controls for HVAC systems
20 April, London

Building services explained
22-24 March, London

Lighting and efficiency energy
25 April, London

Low and zero carbon energy technologies
25 April, London

ENERGY ASSESSOR TRAINING

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

Air conditioning inspector
6 March, London

LCC building design and EPC
21-22 March, London

Heat networks code of practice
29-30 March, London

LCC building operations and DEC
19-21 April, London

LCC building design and EPC
25-26 April, Manchester

CIBSE GROUPS, SOCIETIES AND REGIONS

For more information about these events visit: **www.cibse.org/events**

East Midlands: BIM update
7 March, Northampton

Scotland: Technical seminar
7 March, Inverness
Series of three afternoon presentations: Understanding swimming pool ventilation; Energy efficient ventilation; Soft landings in practice.

West Midlands: LED Lighting Technology
8 March, Birmingham
CPD seminar, with speaker Roger Sexton, Xicato, and Thomas Bray, Holder Components.

Home Counties North West: Air quality and natural ventilation
9 March, London
Health impacts, the planning context, seasonal and diurnal variations, and innovative filtration solutions to improve indoor air quality.

Merseyside and North Wales: Liverpool Football Club visit
9 March, Liverpool

SoPHE: Water pressure control in tall buildings
13 March, Cambridge
With speaker Arnd Bürschgens, Honeywell.

Southern: Lighting in the past
14 March, Southampton
Team challenge to light internal and external parts of the historic structure of Tudor House and Garden, the oldest building in Southampton.

North East: Membership briefing
14 March, Gallowgate
Focus on applications for Associate and Member grades, and registration with the Engineering Council at the Incorporated and Chartered Engineer levels.

SoPHE: High-performance buildings
15 March, Manchester
Presentation by Gareth Sharples, Grundfos Pumps.

Junior Ready Steady Light
18 March, Sidcup
Annual Society of Light and Lighting challenge for teams of young people aged 11-16.

UAE: Laboratory airflow control
20 March, Dubai
Presentation by Patric Underdorfer, Trox.

Home Counties North East: The resilient interconnected city
21 March, Colchester
A look at case studies of seven cities, with speaker Robert Diamond.

West Midlands: Psi values – or are they lie values?
22 March, Birmingham
With speaker Chris Macey, of Wintech Group.

Energy Performance Group AGM
22 March, London

Merseyside and North Wales annual lunch
24 March, Liverpool

SLL masterclass
30 March, Bristol
Continuing the Society of Light and Lighting knowledge series, focusing on human responses to light.

REHVA Annual meeting
2 April, London

CIBSE ASHRAE Technical Symposium

5-6 April, Loughborough University

The theme of the 2017 symposium is 'Delivering resilient high-performance buildings', and more than 50 peer-reviewed papers will be presented over the two days. The aim of the symposium is to show evidence of the successful adoption of resilience in the design and operation of buildings. Tom Lawrence, from the University of Georgia, Atlanta, will be looking at how smart grids offer the potential for smart buildings to participate in load-management and demand-response programmes with local grid operators. Other confirmed speakers include Sophia Flucker, of Operational Intelligence, who will examine the environmental impact on data centres of embodied energy in materials and the grid power source, and Kevin Kelly, of Dublin Institute of Technology, who will uncover a new interior lighting design methodology. To book your place and for more information visit **www.cibse.org/symposium**

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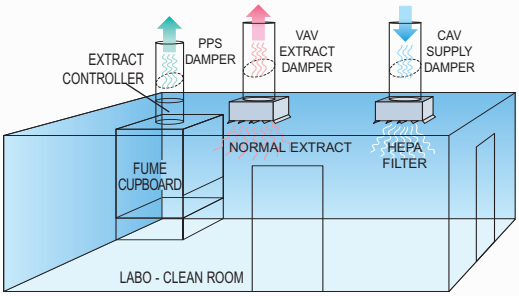

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