CIBSE JOURNAL

The official magazine of the Chartered Institution of Building Services Engineers

May 2016

WITH THIS ISSUE Commercial Heating Special

RESEARCH & DEPLOY
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THE FIXERS

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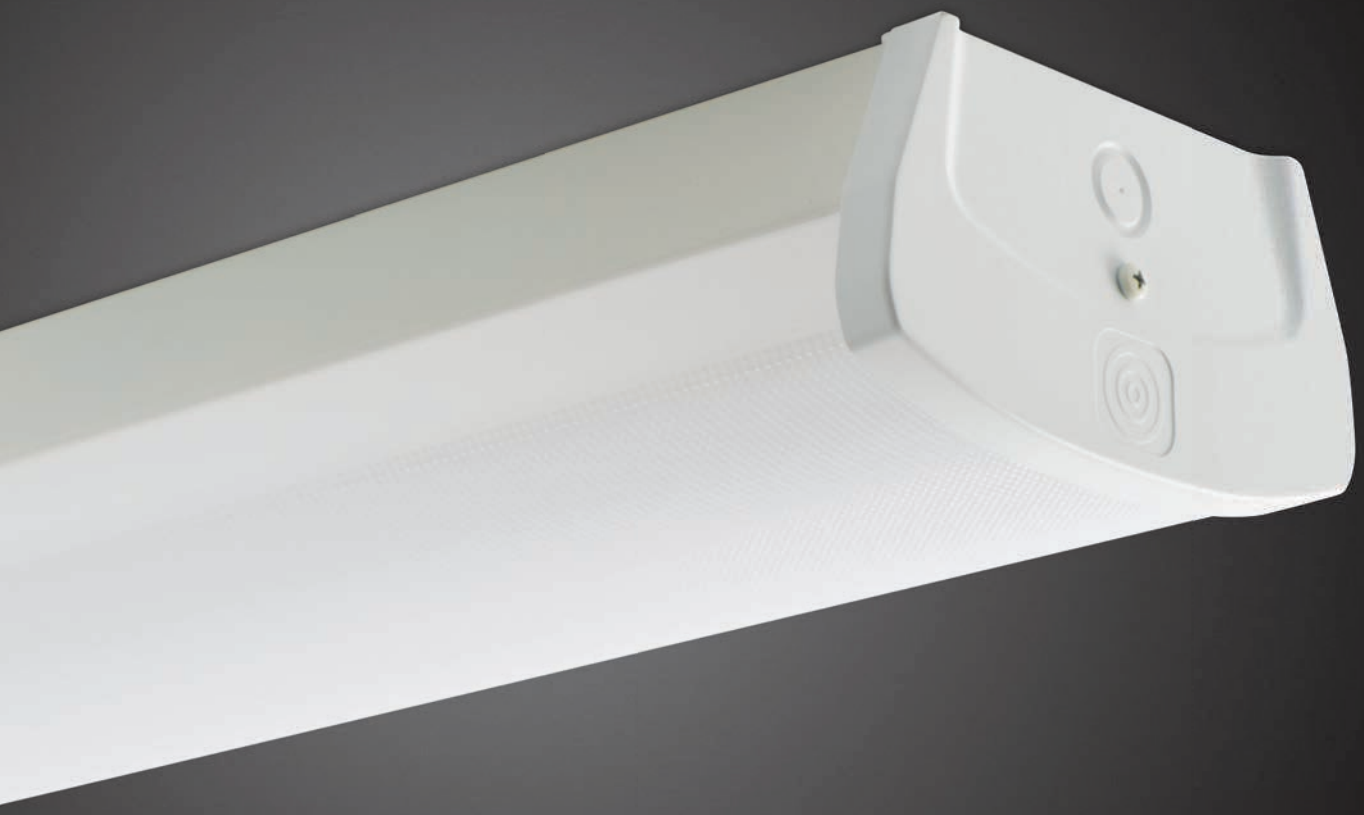

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Cover image: Simon Weir

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Enlightened times

Big data is ubiquitous in the financial industry, and is making major inroads into the property market, but there are no equivalents of FinTech and PropTech startups in our sector. Until recently, that is. Now two firms are analysing the data of buildings and energy networks to identify the root causes of poorly performing systems.

Demand Logic uses sensors on HVAC equipment to monitor the performance of building systems. A pilot project at King's College London uncovered potential annual savings of almost £390,000. Now big hitters such as the Crown Estate and Canary Wharf are using the platform to cut energy use by up to 30% in their buildings (see page 12 of the commercial heating supplement).

Another startup could have a similar impact in the heat network sector. Sister firms Guru Systems and FairHeat have been working with operators to identify reasons for poor performance. Managing directors Casey Cole and Gareth Jones call their data monitoring and bill payment companies disrupters; their software platform's ability to highlight poor performance could transform an industry struggling to design and operate efficient systems successfully.

Jones and Cole have monitored thousands of data points across mulitple heat networks and identified performance standards that need to be met to ensure they operate efficiently. Some operators now intend to write these requirements into contracts.

> These is good news. Actual data is being fed back to system designers

Cole and Jones' work is allied to the *Heat Networks: Code of Practice* published by CIBSE and ADE. The performance standards could potentially be used to verify that the code has been followed.

Guru Systems generates income by charging firms to extract data from their heat networks, then training operators to optimise systems. But the firm realised that sharing the two streams of data underpinning design calculations would give engineers confidence to specify smaller pipes and plant, cutting both Capex and energy use.

This is good news. Actual data is being fed back to system designers. No greater evidence of this was given by the BRE's John Henderson at the Technical Symposium, who said monitoring of heat networks had uncovered an underestimate of distribution losses. The next version of SAP could potentially take this into account, but Henderson said more generous distribution loss factors may be allowed if the code of practice is followed. Hopefully, this will open a path to well designed and operated heat networks.

Alex Smith, editor
asmith@cibsejournal.com

NEWS

All the latest news from around the building industry

In brief

SMALL BUSINESSES GET BIM CHECKLIST

The Electrical Contractors' Association (ECA) has released a free 'BIM Basics' checklist for small and medium-size enterprises, highlighting the 'bare essential' requirements to work on BIM projects. The list includes key requirements in capability and skills, software and hardware, processes, and digital information.

Research conducted by the ECA last year found that 54% of contractors with an annual turnover of less than £1m were 'not ready at all' for BIM, while three in 10 firms with earnings of between £1m and £20m were in a similar position.

SHAKE UP FOR TOSHIBA WARRANTY SCHEME

Toshiba Air Conditioning has launched an enhanced warranty scheme based on installer skills and competence.

Installers can qualify for a seven-year enhanced warranty by meeting certain standards, including being F-Gas registered, successfully completing three relevant Toshiba training courses, and by filing commissioning and maintenance reports online.

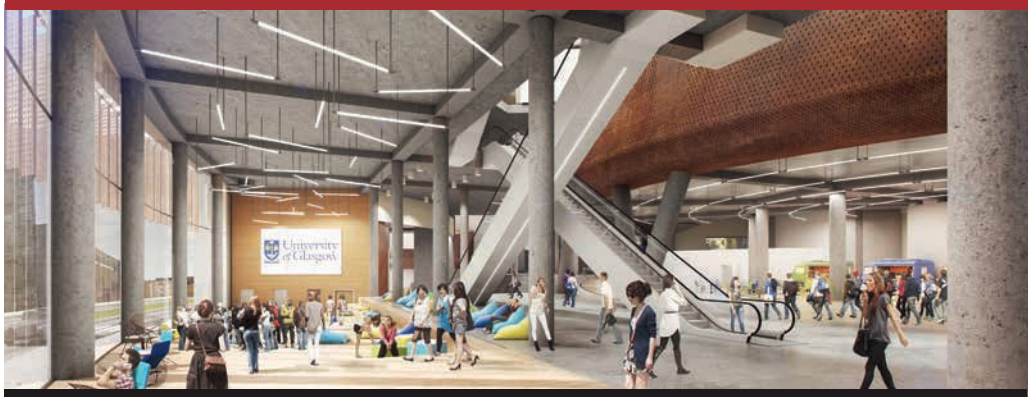
Director and general manager, David Dunn, said what really mattered for warranty purposes was the 'technical proficiency of the installer, and how competent they are in carrying out installation, commissioning and on-going servicing of the equipment' – not how much a customer spends with the manufacturer.

EMPLOYERS OF YOUNG APPRENTICES GET NI BOOST

The government has abolished employer National Insurance contributions for apprentices under the age of 25.

The change came into effect on 6 April and is designed to encourage firms to take on apprentices. It applies to new and existing employees. A £10m fund has also been announced to support apprentices who want to go on to take a degree.

DEGREES OF SUCCESS FOR WSP PARSONS BRINCKERHOFF



WSP Parsons Brinckerhoff has been appointed to work on a new 13,400m² learning and teaching hub at the University of Glasgow's Gilmorehill Campus. Work on the building, which is part of a £1bn development and is being assessed for Breeam, is expected to start in 2017. WSP Parsons Brinckerhoff is providing M&E services and has also been awarded a contract to develop the university's research hub on the adjacent 14-acre Western Campus. WSP Parsons Brinckerhoff's John Cox said: 'It's a major win for our business and reflects our growth and capabilities within the industry.'

CHP is running out of time

● National Grid so 'clean' in places that combined heat and power is not viable

Combined heat and power (CHP) may cease to be a carbon-saving option for many projects within three years, according to a study by Arup engineers.

Reporting their findings to the CIBSE Technical Symposium at Heriot-Watt University, in Edinburgh, Josh Bird, Alper Ozmumcu and Stuart Allison said the rapid decarbonisation of the National Grid was narrowing the opportunities for CHP to save carbon.

The Arup team said there was still a 'window of opportunity for CHP', but – thanks to increasing amounts of renewable energy production – the Grid could be 'clean' enough by 2018, and 'certainly by the early 2020s', to make it redundant in terms of carbon saving. They speculated that some parts of the country might already have reached the point where local electricity supplies were so low in carbon content that it no longer made sense to install CHP.

Scotland, for example, has more renewables in its Grid mix, so CHP might be adding carbon in some projects. But in the north of England, coal still accounts for a large proportion of electricity generation, so CHP will still have a more productive impact for longer.

'We need to use marginal emissions factors to work out exactly what CHP-generated electricity is displacing, so we do not make unrealistic claims for what the CHP is contributing,' said Bird.

But the price 'spark gap' remains significant. This means it may still be economically advantageous for some end users to use CHP to generate their own electricity on site, delegates heard.

Energy consultant Phil Jones said: 'I agree with the issue but if you use the DECC Bespoke CHP grid factors then the problem is medium-term not three years.'

See **www.cibse.org/symposiumpapers2016**

UK's Green Deal 'set up to fail'

The Green Deal and Energy Company Obligation (ECO) failed to stimulate the UK's domestic energy efficiency market or provide value for money, according to an investigation by the National Audit Office (NAO).

However, the UK Green Building Council (UK-GBC) said 'poor management' was to blame and ultimately 'set them up to fail'.

'The Green Deal was a pioneering attempt to bring private finance into the home retrofit market,' said policy adviser Richard Twinn. 'High interest rates limited the amount that could be borrowed under the scheme, and a lack of long-term incentives meant there was insufficient demand from householders. This was compounded by constant policy changes, which made it very difficult for the industry to invest.'

UK-GBC said: 'The government needs to set out a long-term vision and then work with the industry to develop a suite of policies providing a compelling offer to every household,' it added.

See page 16 for Hywel Davies' overview of the NAO report on the Green Deal and ECO.

BBP to test if everybody needs good Nabers

Pilot study to investigate Commitment Agreement

The Better Buildings Partnership (BBP) is to pilot a Nabers-style Commitment Agreement for offices in the UK.

Nabers is a rating scheme used in Australia to measure the environmental performance of buildings, tenancies and homes. It ran as a voluntary scheme for 10 years before the federal government mandated disclosure of base building operational energy performance for offices with a net leasable area (NLA) of more than 2,000m^2.

A Commitment Agreement is a formal contract – lodged with the Nabers Administrator – where a developer commits to achieving a specific post-construction, in-use base building energy rating, for which 12 months' operational data is required. In return, the developer may advertise the rating before its measurement in use.

This has commercial benefit in Australia because many tenants seek – and pay a premium for – good Nabers ratings. Guaranteed energy-performance ratings also attract green bond investors in Australia, and the same investor class is keen for something similar to be established in the UK.

Nabers measures the performance of large Australian offices

GRAVITY IMAGING / SHUTTERSTOCK

The BBP pilot will involve about 10 studies between April 2016 and September 2017. These will be divided between the five stages of the Soft Landings process, depending on which phases of the project apply within the 18-month window. This will allow the main bits of a Commitment Agreement to be tested without having to go through the full construction cycle.

BBP hopes to design out the base building metering issues encountered in existing offices when it developed the Landlord Energy Rating in 2013.

Nabers was the subject of three papers presented at the Technical Symposium in March. For more on these, see page 20.

CIBSE is revising TM39 on metering, in association with the Nabers pilot project, which CIBSE is working on with the BBP team. See 'Everybody needs good Nabers' in December 2015 *CIBSE Journal*.

Former chief scientific adviser Sir David MacKay dies, aged 48

Tributes have been paid to Professor Sir David MacKay, the University of Cambridge's regius professor of engineering, who has died aged 48.

MacKay served as chief scientific adviser to the Department of Energy and Climate Change between 2009 and 2014. He rose to prominence after the release of his 2008 book *Sustainable Energy – Without the Hot Air*.

CREDIT: DR DAVID STERN

MacKay was diagnosed with terminal cancer last year and documented his illness on a personal blog, where he thanked those who had offered to visit him in hospital.

A graduate of Trinity College, Cambridge, MacKay later studied as a Fulbright Scholar at the California Institute of Technology (Caltech), before being appointed a Fellow of the Royal Society in 2009.

He was knighted in the 2016 New Year's Honours list 'for services to scientific advice in government and science outreach'.

Max Fordham engineer, Joel Gustafsson, worked with MacKay on a new energy cost matrix for Cambridge University Engineering Department's facilities in West Cambridge.

Gustafsson said: 'He was very keen to insert his clarity of thought and passion for arithmetic into the design and procurement process.

'He was a great thinker and a passionate achiever. His death is a loss to all who knew him, as well as those who didn't.'

Solar installations fall by 75%

Domestic solar installations have dropped by three-quarters since government subsidies were cut, according to new industry figures.

In February and March this year, 21MW of small solar was installed, compared with 81MW during the same period in 2015, when Feed-in Tariff payments were 65% higher. This has led to a number of businesses closing down, but the Solar Trade Association believes there are still grounds for optimism.

'The market is going through a very difficult time, with deployment down considerably compared to this time last year… because of the cliff-edge cut to the feed-in tariff,' said business analyst David Pickup.

'However, we are confident solar can still provide an attractive investment in certain circumstances, and that the market will recalibrate by selling solar as a package with other cutting-edge smart technology.'

Adapt UK gas grid to reduce carbon, MPs told

The All-Party Parliamentary Group for Energy Studies has heard that the UK must decarbonise its gas grid in order to meet climate change targets.

Rather than 'ripping out' existing heating technologies – and throwing away the billions of pounds already invested in the gas network – infrastructure and heating systems could be adapted to use alternative 'green' gases, MPs were told.

'Decarbonising heat is a must,' Mike Foster, chief executive of the Energy and Utilities Alliance (EUA), told the latest meeting of the group. 'Improving the energy efficiency of UK homes is vital if we are to reduce carbon emissions and keep bills down – but, on its own, that won't be enough.' He said decarbonising the gas flowing through the grid was 'the obvious solution'.

The National Grid and gas-equipment manufacturers joined Foster's call for a decarbonised gas network using 'green gas' alternatives such as biomethane and hydrogen.

In brief

ASHRAE REVISES INDOOR AIR QUALITY STANDARD

ASHRAE has revised its standard for indoor air quality.

ANSI/ASHRAE Standard 62.1-2016, *Ventilation for Acceptable Indoor Air Quality*, sets minimum ventilation rates and tackles the issue of tobacco smoke and other contaminants in commercial buildings.

'The latest version of Standard 62.1 contains changes that affect high-rise residential spaces, the indoor air quality procedure, laboratory exhaust and demand control ventilation,' said Hoy Bohanon, chair of the Standard 62.1 committee.

It revised the definition of 'environmental tobacco smoke' to include emissions from electronic smoking devices and from smoking cannabis, and it adds requirements for determining minimum ventilation rates by considering the combined effect of multiple contaminants on human organs.

The new standard also allows for ventilation rates to be cut to zero through occupancy sensors in certain spaces.

Visit **www.ashrae.org** for more information.

HISTORICAL BUILDINGS GUIDELINES TO BE PUBLISHED

A consultation for Ashrae's Energy Guidelines for Historical Buildings will end on 2 May.

The guidelines lay out the practice, processes and workflows that should be followed by those involved in energy efficiency and energy conservation improvement projects.

UK missing out on surface water source energy

New Code of Practice launched at Thames site

The UK has been ignoring one of its greatest renewable sources by failing to exploit energy from the sea, rivers, canals and lakes to provide heating and cooling in buildings, according to Phil Jones, chairman of the CIBSE CHP and District Heating Group.

Jones told last month's CIBSE Technical Symposium in Edinburgh, that surface water source heat pumps (SWSHPs) were a hugely underused technology and would be the next great breakthrough in renewable energy; the government, he said, was poised to provide a funding boost through the revised Renewable Heat Incentive.

Phil Jones presenting on SWSHPs at the symposium

He said SWHPs were particularly suitable for the UK and the freely available water source heat map produced by the Department for Energy and Climate Change would help to open up the market.

CIBSE has produced a Code of Practice for SWSHPs in partnership with the Heat Pump Association and the Ground Source Heat Pump Association to make sure 'we don't get this wrong as the market starts to accelerate', said Jones.

The voluntary code sets minimum standards and is accompanied by training courses, which start at CIBSE this month. CIBSE is also working with the Canal & River Trust to identify good sites for SWSHPs in terms of MWh per metre demand close to a surface water source.

'This means we can go and knock on the doors of nearby potential users and give them a strong economic case,' Jones said.

The code was launched at Kingston upon Thames, where SWSHPs have been installed. Read 'A river runs through it' on page 34 of the January 2014 *CIBSE Journal*.

For more information, visit **www.cibse.org/CP2**

UK defies Europe to keep special low VAT rate on energy measures

The government is set to ignore a European Court of Justice ruling on lower rates of VAT for energy saving measures (ESMs).

Last summer, the court ruled that the UK's special 5% rate on draughtproofing and insulation, solar panels, heating and hot water controls, ground and air source heat pumps, small combined heat and power systems, wind turbines and biomass boilers was illegal.

As a result, it was expected that the UK would have to impose the standard 20% rate on all ESMs from this August adding considerable additional cost to energy saving improvement projects.

But the Labour Party tabled an amendment to the new Finance Bill empowering the Treasury to retain the 5% rate and this was supported by the Prime Minister. Labour leader Jeremy Corbyn urged the government to go further and consider a zero rate on energy saving work in a bid to reduce fuel poverty.

New London mayor urged to prioritise energy efficiency

London's low carbon market will be worth £52.6bn by 2024

The new Mayor of London should put decentralised energy production and energy efficiency at the top of their 'to do' list, say leading industry figures.

Lord Barker, chair of the London Sustainable Development Commission, said there were already several projects making good progress and proving that 'it is increasingly economically and commercially feasible' to deploy renewables and sustainable energy 'within a large metropolis in a way that is scalable and makes sense for consumers'.

Speaking during a debate hosted by the Aldersgate Group, an alliance of leaders from business, politics and society that drives action for a sustainable economy, Lord Barker urged the new mayor [to be elected on 5 May] to liaise with the Department for Energy and Climate Change early and 'insist that the new regime that replaces ECO takes into account the special conditions that we need for London' such as the higher costs for energy efficiency initiatives.

Election front-runners Conservative Party candidate Zac Goldsmith, left, and Labour candidate Sadiq Khan

DAN KITWOOD / GETTY IMAGES

The debate heard that, as the fifth-largest city economy, London could – and should – be 'a leader in the international low carbon economy'.

A report commissioned by outgoing mayor Boris Johnson found that the market in London for low carbon and environmental goods and services was worth £25.4bn in 2013 – and could more than double to £52.6bn by 2024.

Duncan Price, director for sustainability at Buro Happold Engineering, said more needed to be done to drive the real time management of energy in the capital's buildings. He added that there was a 'well-known performance gap between the design and reality of buildings... and [how] performing in practice is the real challenge to bring energy use down in existing buildings'.

'If you can't get the economics to work in London [where it is desirable to live], then it's not being valued correctly'.

Zero Carbon Hub closes with parting shot at ventilation in new homes

The Zero Carbon Hub closed down at the end of March, following the government's decision not to pursue zero carbon targets.

Set up in 2008, the Hub was tasked with both translating zero carbon building aspirations into government regulation, and 'to remove the barriers to its implementation', but its funding has now been withdrawn.

The Hub's chair, Paul King, described it as 'a model of collaboration between industry and government'.

One of its final acts was to publish a damning report into overheating and the use of ventilation systems in new homes, which it said was leading to poor standards of indoor air quality, condensation and mould growth.

It found that many home ventilation systems were not properly understood by the building's occupants and many designs were failing to comply with Part F of the Building Regulations.

All the information will remain on the Zero Carbon Hub website at **www.zerocarbonhub.org**

Find CIBSE's guidance on overheating at **www.cibse.org/knowledge**

IFANG / SHUTTERSTOCK

Humidity big threat to data centres

Relative humidity is a greater threat to the reliability of 'free-cooled' data centre hard drives than high temperatures, according to a study by Rutgers University in partnership with GoDaddy and Microsoft.

The effects on controllers and adapters in more than one million drives were tested by the researchers in nine Microsoft data centres over four years. The humidity-related failures were so high that observers could tell which free-cooled data centres had humidity controls and those that did not.

However, the team also concluded: 'Though higher relative humidity increases component failures, software availability techniques can mask them and enable free-cooled operation, resulting in significantly lower infrastructure and energy costs that far outweigh the cost of the extra component failures'.

Data informing SAP changes

BRE is to change some values in SAP – the method used to prove compliance with Part L – after testing existing values in actual buildings and heat networks.

Speaking at the CIBSE Technical Symposium, BRE's John Henderson said the organisation was using real data to check the values in SAP 2012.

He said monitoring of 11 heat networks had revealed that distribution losses in heat networks were underestimated.

Currently, distribution loss factors (amount of heat used to get one unit of heat into a home) ranges from 1.05 to 1.20. but Henderson said the data revealed an average of two, which would be the proposed default in the new SAP. This would go down to 1.5 if the Heat Networks Code of Practice was used, or actual data submitted.

Another proposed change is the airflow value for chimneys. The figure is currently 40m^3 per hour, but tests revealed a value of 80m^3, which is the proposed new SAP figure. The SAP consultation is due late 2016.

Read the Symposium papers are at **www.cibse.org/symposiumpapers2016**

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Governance Review

As reported in the April *Journal*, the outcome of the Governance Review is being taken forward under the leadership of retiring CIBSE President, Nick Mead. Working groups are being established to look at the key areas for implementation, and further information will be provided in future issues of the *CIBSE Journal* and on the Institution's website.

Still time to enter CIBSE's YEA

The 2016 CIBSE Young Engineers Awards are open for entries.

Comprising Employer and Graduate of the Year prizes, the awards celebrate the industry's best young engineering talent, as well as employers' strategies for recruiting, nurturing and empowering young people. The Graduate of the Year wins a trip to the ASHRAE Winter Meeting, in Las Vegas, in January.

The presentation will be at the Institution of Mechanical Engineers on 13 October. To enter, visit **www.cibse.org/yea**

Speirs + Major outshine rivals at Ready Steady Light

- **SSL members lead 15 teams in annual competition**

CREDIT: MARCUS STEFFEN

Lighting design practice Speirs + Major bagged two out of three awards at the 14th Ready Steady Light event, run by the Society of Light and Lighting (SLL).

The competition took place at Rose Bruford College, Sidcup, in March, when 15 teams competed to design and set up temporary exterior installations in only 180 minutes. Speirs + Major won the Best Technical Solution, judged by SLL, and the Peers prize, judged by the teams. Aecom claimed the Most Creative Effect Award, judged by the International Association of Lighting Designers (IALD).

Each team was allocated a site around the campus and – focusing on basic engineering and design – had to light it in its natural state with designated equipment, overcoming challenges without a budget and within time constraints.

Organisations were only allowed one team, led by an SLL member. Students on Rose Bruford College's lighting and design BA course, who supported the event, had the chance to assist professionals working in this unique environment.

Ready Steady Light is held in partnership with the college, and supported by the IALD. Further support and equipment is supplied by Philips, Lee Filters, Whitelight and Anolis. The teams came from a variety of organisations, including Aecom, Brunel, Future Designs, GIA Equation, Light Bureau, MID Lighting, Nulty+, Philips, Rose Bruford, Speirs + Major, Thorlux and University College London.

The SLL and Philips also sponsor Junior Ready Steady Light, which took place in March and included teams from state schools, further education colleges and art organisations.

Resilient Cities Group makes its debut at Brunel

The CIBSE Resilient Cities Group held its first event last month – a seminar at a conference run by the Institute of Energy Futures. 'Adapting Buildings for Resilient Cities' was one of four conference streams at the Brunel University event, and was organised in conjunction with Professor Maria Kolokotroni.

The keynote address was given by Nick Winser, chair of Energy Systems Catapult, who said industry could not rely on government to meet the climate change objectives in the Paris Agreement. He added that 'deploying expensive solutions will not retain political or public support', and that there was an opportunity to use data.

George Adams

George Adams, chair of the Resilient Cities Group, said designers need to take a whole-life approach to construction, and that the specification of reusable systems was necessary to make significant cuts in carbon.

Susie Diamond, partner at Inkling, addressed the issue of overheating in homes, and explained how modelling could predict the metabolism of a building. A methodology was needed to predict, at design stage, if a home will overheat, she said, adding: 'It should be reliable, cost effective, flexible and easily understandable.'

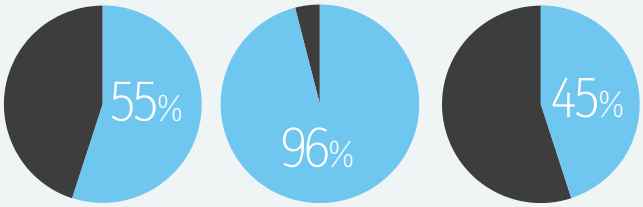
Rajat Gupta, of Oxford Brookes University, discussed how suburbs can be adapted for a changing climate. He said external temperatures could be reduced by managing the microclimate and said retrofitting for climate change should be carried out alongside low carbon refurbishments.

Angus Cunningham, managing director of Scotscape, discussed research from the University of Sheffield on the impact of living walls on internal temperatures. He said establishing a U value for green walls was difficult because there were too many variables.

The urban heat island (UHI) effect was tackled by Kolokotroni and Geoff Levermore, of the University of Manchester. They said UHIs in Manchester and London contributed up to 8°C of warming at night, and less during the day, and urged engineers to take the wider built environment into account when designing buildings.

Full details of the presentations are on the Resilient Cities Group website **http://bit.ly/1qHIF0A**

In numbers: CIBSE Membership 2016 Survey



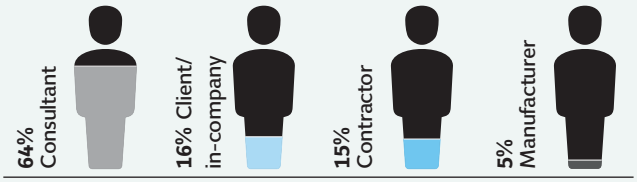
55% of respondents intend to progress their membership grade
96% would recommend CIBSE to a colleague
45% work for consultancy firms

The top five CIBSE membership benefits for UK and international members are:

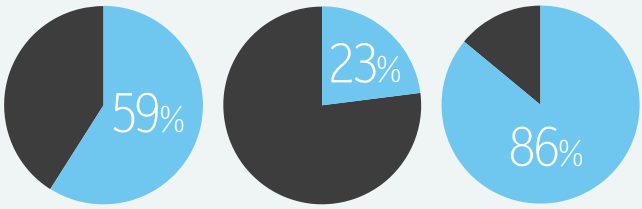
- *CIBSE Journal*
- Knowledge Portal
- Professional registration
- Special interest groups
- E-newsletter

Top five UK sectors people work in:

What type of organisation do you work for?



59% use LinkedIn
23% do not use any social media
86% rate the value of membership as excellent, very good or good



Jellie lifts trophy as CIBSE ANZ celebrates young engineers' talent

The CIBSE ANZ region took a cruise around Sydney Harbour to celebrate the outstanding contribution from its leading students and graduates, who continue to demonstrate engineering excellence within the built environment.

Alex Jellie, from Northrop Consulting, was named CIBSE ANZ Graduate of the Year. He impressed the judges with his work within the health, transport and commercial sectors. They were particularly struck by his experience on the Illawarra Health Precinct project, where he was the lead mechanical designer.

The judging panel also recognised Jellie's work in project coordination, where he was responsible for the delivery of multidisciplinary projects. He received an engraved glass trophy, certificate and a cheque for Au$1,000.

Bin Chen, from WSP Parson Brinckerhoff, received a highly commended runner-up award. Chen's strong analytical skills, and experience of working in a range of jurisdictions and countries, impressed the judging panel.

Lorna Hennessy, Aecom and University of Technology Sydney (UTS), took the Student of the Year award. She has just completed her second year at UTS and is completing her internship at Aecom.

The judging panel particularly liked her enthusiasm for learning, as well as her knowledge of how the various building services disciplines interact to affect the overall building performance.

The awards are presented annually at the CIBSE ANZ function in Sydney.

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Gill Francis, senior membership development officer, said: 'CIBSE has seen an increasing number of applications for the Member Incorporated Engineer route, created for those who are able to satisfy the competencies for the member grade, and who hold an accredited qualification.'

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Brian Moss was awarded the CIBSE Gold Medal in 2009 for outstanding service to the Institution

Obituary
Brian Moss OBE

One of CIBSE's most distinguished and recognisable members, Brian Moss, OBE FCIBSE, sadly passed away last month. Well known within CIBSE and across much of the heating, ventilating and air conditioning industry, he was involved with a very broad spectrum of activities and achievements, for the Institution and elsewhere.

Brian was born in London on 7 April 1936. He went to Latymer Upper School and then read mechanical engineering at the University of Nottingham.

His sporting activities were largely concentrated on swimming; a member of Ealing Swimming Club, Brian occasionally competed for Middlesex.

Brian was president of CIBSE for 1992/1993. He had been a member of the Institution since 1976 – and a fellow since 1986 – and participated in its activities before, and long after, becoming president. He was made an honorary fellow in 1999 and awarded the Institutions' Gold Medal in 2009 for his outstanding service to CIBSE. As well as treasurer of CIBSE from 1993 to 1998, Brian was a board member of the Institution for a considerable period.

He also served on many committees, including the Publications and Research Outputs Delivery (Prod) committee, for which he was chairman from its inception in 1999 until 2012. As a result of Brian's vision for Prod, the Institution now has a Knowledge Portal, making it the only professional engineering body with its technical guidance online as a member benefit.

CIBSE is a charitable organisation, but it does have a commercial entity – CIBSE Services – so Brian's industrial and financial expertise made him the ideal member to act as the Institution's director of services. This is an important and sometimes fraught role, which he carried out very successfully for many years. He took great care when assessing proposed projects for CIBSE Services, to ensure they had positive financial implications.

In the 1990s, Brian was one of the CIBSE members who improved the Institution's working relationship with the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) – and the relationship has prospered ever since. He was not afraid to voice his opinion about some of ASHRAE's attitudes and activities, and its members listened to, and respected, Brian's views.

Everybody found Brian very approachable and prepared to listen. At committee meetings, he would always allow the differing views of the participants to be discussed, and would happily accept suggestions to improve tabled proposals. Only very rarely did he need to 'put his foot down', and he was always calm.

Socially, he was a delightful person to have at any gathering and he would chat equally to friends, acquaintances and people he'd never met before.

CIBSE was an 'outside' interest for Brian,who was the managing director, and then chairman, of fan manufacturer Nuaire for several decades. Because of his knowledge of the product manufacturing side of the industry, he became involved with the Heating Ventilating and Air Conditioning (Hevac) Association, which represents the various non-professional sectors of the industry. He was elected its president from 1982 to 1984.

Brian became a liveryman of the Worshipful Company of Fan Makers in 1984 and was awarded its Gold Medal in 2009 for his work in the field of mechanical fans.

Among his other activities, Brian chaired a committee for the Engineering & Physical Sciences Research Council for several years. Its role was to evaluate research proposals for financial support in our sector of the industry.

Brian was made an OBE in 1986 for his services to the National Economic Development Office.

He was a long-standing member of The Rumford Club, a dining and discussion forum attended by senior personnel from across the industry. He became a member in 1979, was made chairman in 1993/94, and became an honorary member in 2006.

Brian was very family-orientated, and enjoyed spending time with his wife, Jill, his two grown-up children, his grandchildren and his wider family. Art and sculpture were passions of his and – when he could find the time – Brian and Jill would visit galleries and exhibitions. They collected paintings and sculptures.

Fervently involved in all the organisations he was associated with, Brian particularly supported all CIBSE functions and activities. He was a generous contributor to various charities.

For the past five years, Brian had an aggressive form of cancer, but refused to let it interfere with his activities. He died on 2 April 2016, aged 79.

He will be sorely missed by all who knew him, whether they be family, friends or colleagues.

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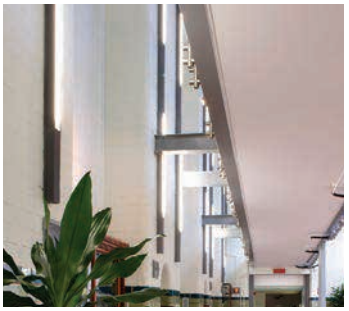


RIDI Venice brings a fresh take on LED style.

Feedback

A reader questions how legionella is dealt with in a solar thermal pre-heat vessel, and LinkedIn members discuss last month's CIBSE Technical Symposium debate

Ewen Rose speaking at the Technical Symposium debate

Water safety

I was very interested to read Peter Filbert's article on the use of plate heat exchangers (PHEs) in place of storage vessels ('Served up on a plate', *CIBSE Journal*, April 2016). I have been looking at this recently, but have generally been wary due to legionella risk because of scale build-up (which he states is minimal). I am glad to hear this and that the method is being used.

The use of a pre-heat vessel from solar thermal is suggested; however, I cannot see how legionella is dealt with in this case. To be worthwhile, you would want your storage vessel to be at a significantly lower temperature than 60°C – that is, within the legionella growth temperature. So you need to guarantee that the water was heated up to the kill temperature (~60°C) for around two minutes before being used, which is impossible with a PHE. The only solution I have come up with is to add another heat exchanger between the buffer vessel and the domestic hot water (DHW).

Julian Cottrill, Skelly & Couch

Stokvis replies:

The article doesn't actually talk about combating legionella and solar thermal in the same paragraph. However, I would comment on different systems as follows:

1. Plate heat exchangers, no solar preheat on cold feed or buffer storage on the hot water system (HWS) –ideal at combating legionella since cold water around 10°C enters the plate heat exchanger and exits at 60°C.
2. Plate heat exchangers and HWS buffer vessels – still very good at combating legionella since the buffer storage is minimal and the plate heat exchangers have a very high kW rating and could heat the storage from cold in five to 10 minutes (not that the plates would generally have to heat the vessel water from cold).
3. Plate heat exchangers with a solar preheat vessel on the cold feed line – probably the best set-up efficiency-wise, because the boilers would only input to top up the HWS temperature via the plates. With regard to combating the possibility of legionella, not the best solution, since the preheat relies on having a cold-storage capacity to accommodate the solar-thermal input and, in these arrangements – when solar thermal input is very low – an anti-legionella pump/loop should operate.

Paul Sands,
Stokvis energy systems

> We can all do better; we should care about the planet and poor communities

LinkedIn members discuss the Technical Symposium debate

Ant Wilson FCIBSE

The first day of the CIBSE Technical Symposium, at Heriot-Watt University, closed with a light-hearted debate, 'Putting our head above the parapet is impossible with the present industry structure'. I kept quiet and listened. I believe fear stops people standing up during debates and that we can't make a difference by keeping quiet. There is no excuse to just follow the norm. Looking after our planet and using fewer natural resources is vital.

I do want to speak up for what is right. I should have joined the debate and supported those who put their heads above the parapet. We can all do better; we should care about the planet, environmental issues and poor communities.

Pete Halsall

Here, here. You can't be ruled by fear. If you are, then I can tell you, as a client, there is no respect. However tough and commercial a client is, you always want an adviser who knows their own mind and isn't afraid of that. Ultimately, repeat business comes from doing the job well and not being a puppy dog. Sustainability, like evolution, is only going one way, for reasons that seem pretty darn obvious now to pretty much everybody.

John Curley

Putting your head above the parapet is often difficult – but, then, doing the right thing is not going to be easy.

CIBSE Journal welcomes readers' letters, opinions, news stories, events listings, and proposals for articles.
Please send all material for possible publication to: editor@cibsejournal.com 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.

TIME TO HEAD WEST?

There has been a flurry of reports on the effectiveness of energy efficiency schemes in the UK and the US. **Hywel Davies** considers what we can learn from their reviews

The American Council for an Energy Efficient Economy (ACEEE) has been reviewing the effectiveness of various energy efficiency programmes. Meanwhile, the UK National Audit Office (NAO) has reported on the Green Deal and Energy Company Obligation (ECO).

ACEEE has been advocating for greater energy efficiency in the US economy for 40 years. Its fact sheet, *How much does energy efficiency cost?*[1] summarises detailed analyses of US energy efficiency programmes by Lawrence Berkeley National Laboratory (LBNL) and the ACEEE itself.

LBNL found that the average cost of energy efficiency measures over the life of a programme was 2.4 cents per kWh saved, while ACEEE showed a slightly higher average cost of 2.8 cents per kWh.

ACEEE included the costs of incentive schemes for utilities to reward savings, while LBNL did not. By comparison, investment in new generating capacity in the US costs from five cents per kWh on average for wind, to significantly higher costs for new coal, biomass and nuclear capacity.

ACEEE shows how energy efficiency can also contribute significantly to meeting the Clean Power Plan targets that each US state must implement to reduce emissions, as well as the costs of clean power, by 2030. So the world's largest emitter of carbon dioxide is showing that energy efficiency reduces energy demand cost effectively, cuts emissions and avoids investment in new capacity.

None of this is particularly novel, clever or difficult, but it works. And the LBNL study shows how many states in the US have benefited from this approach – even in a free-market environment.

Meanwhile, in London, the NAO report on the Green Deal and ECO was published on 14 April.[2] These two policies were implemented in 2013, aiming to improve household energy efficiency to reduce CO_2 emissions.

ECO requires the largest energy suppliers to install measures in homes that will cumulatively reduce CO_2 emissions, with penalties for suppliers that fail to comply. Suppliers, who pass on their costs to all customers through energy bills, have been obliged to improve homes' energy efficiency in this way for more than 20 years.

Green Deal was a mechanism to enable householders to borrow money – Green Deal Finance – to improve the energy efficiency of their homes, repaying it through their energy bills. This was complemented by a framework of advice, accreditation and assurance intended to increase homeowners' trust in the supply chain for home improvements.

Together, the schemes supported three strategic aims of the coalition government: to reduce emissions of greenhouse gases; improve energy security; and mitigate fuel poverty.[3]

Launched to great fanfare, the Green Deal led to finance packages for around 14,000 homes, with the Department of Energy and Climate Change (Decc) claiming that another 35,000 homes were improved as a result of Green Deal advice and assessments. In 2015, the government announced that it would not give further funding for the Green Deal, and the ECO is due to be replaced in 2017 by a lower-cost scheme.

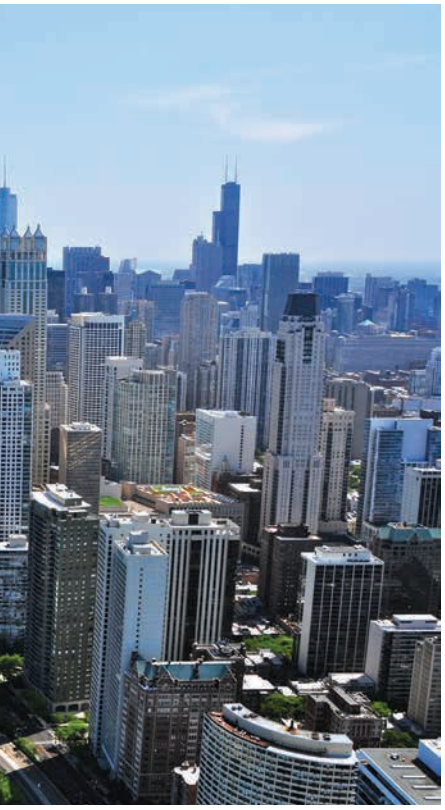
The NAO monitors value for money of government spending. Summarising the review findings, Comptroller General Amyas Morse concludes: 'Improving household energy efficiency is central to government achieving its aims of providing taxpayers with secure, affordable and sustainable energy.

> The tragedy of the Green Deal debate is that it has given energy efficiency a really bad name in the UK

The energy disclosure law in Chicago helps to drive energy efficiency in the US

Decc's ambitious aim to encourage households to pay for measures looked good on paper, as it would have reduced the financial burden of improvements on all energy consumers. But, in practice, its Green Deal design not only failed to deliver any meaningful benefit, but it increased suppliers' costs – and, therefore, energy bills – in meeting their obligations through the ECO scheme. The department needs to be more realistic about consumers' and suppliers' motivations when designing future schemes to ensure it achieves its aims.'

The review concludes that, while 'a million homes were improved through the combined efforts of the two schemes, the focus on "hard to treat" solid-walled dwellings increased costs per dwelling'.



RICHARD CAVALLERI / SHUTTERSTOCK

The report fails to address the impact of the Green Deal on private sector organisations,[4] which invested significant sums preparing to provide services – from advice and assessments to specific improvement measures and financial packages – under the scheme. However, many lost money on the Green Deal, and will be doubly sceptical in future, when government seeks to mobilise its efforts in support of its policies.

The real tragedy of the Green Deal debacle is that it has given energy efficiency a really bad name in the UK.

Before we throw this baby out with the Green Deal bath water, perhaps we should look across the Atlantic and see how energy efficiency in a market economy can deliver lower bills, improve energy security, reduce investment costs for new capacity and cut emissions. All we have to do now is 'go figure' how to make it work over here.

References:

1 **http://aceee.org/fact-sheet/cost-of-ee**

2 **www.nao.org.uk/report/green-deal-and-energy-company-obligation/**

3 In England, households are considered fuel poor if the cost of heating their home is above average, and meeting these costs would leave them with an income below the poverty line.

4 Including CIBSE, which was accredited under the Green Deal

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

DARE TO GO ULTRA LOW

Competitive bidding, a lack of science education and an outdated taxation system are all preventing a move to ultra-low CO_2 buildings says **Gareth Young**

All over the world, engineers are beavering away, designing building services for buildings. These new builds, and refurbishments, may stand for a hundred years, consuming energy. What decisions should these engineers be making?

We are faced with a myriad of technical choices, some unproven in the long term, some tried and tested; we could make choices that will influence how the whole construction industry re-directs itself to coping with global warming.

Some of us are old enough to remember the large-scale transition from coal to natural gas in the 1970/80s. It was painful, expensive and traumatic at the time. We made lots of bad decisions – all forgotten now because everybody sees the advantages of gas.

Another success story is insulation. Buildings insulation standards have improved fantastically, and pretty much the whole construction industry is on board for insulation. It was not always so – the construction industry fought tooth and nail against improving insulation standards, but, gradually, solutions were found.

So we can adapt to change when necessary.

Most of the UK and Western Europe is set up to use gas-fired boilers. Changing to use heat pumps would be a tremendous undertaking, and at the moment, in the UK, it seems we are not embracing the idea. Why is this? The Japanese have been leading the charge in relatively cheap, mass produced heat pumps, but uptake in the UK has been tardy at best.

This may be the fault of our education system – only those who go beyond A level physics get an understanding of what coefficiency of performance (CoP) means, and what latent heat transfer is.

Also, the manufacturing and contracting industries cannot be expected to make these changes in a free-market world of competitive bidding.

Storing coolth is not a new technology. This building in northern Corsica stored ice from a glacier

JON INGALL / SHUTTERSTOCK

The transition from coal to gas was driven by both legislation and technical innovation. I don't believe we will make the transition to an ultra low emissions-based economy without some form of progressive carbon tax. The free market will then sort out which technology is best.

Another technology with significant potential is inter-seasonal energy storage where heat/coolth is stored on an annual basis – summer heat squirrelled for winter use and vice versa. This changes the equation from being one of generation of heat/coolth to one of storage and distribution.

The principle is not new; indeed it might be many hundreds of years old. Stately homes frequently have an ice cave or ice house, within which ice from the estate's lake was stored from winter through to summer, and the Lord and Lady of the manor could enjoy the novelty of ice in mid-summer.

People like Professor Andy Ford and director at ICAX Mark Hewitt have updated this idea to store summer heat underground until winter, when it is abstracted via a heat pump. They are claiming average CoPs of eight, and a peak of 15.

> The contracting industry cannot be expected to make these changes in a free market world of competitive bidding

Aquifer thermal energy storage (ATES), which is widely used in northern Europe, is another example. Here underground aquifers are used as the heat/coolth sink.

Daring to go ultra low must happen; there are many ideas to choose from but, without the leadership and vision to galvanise us behind one good solution, we risk watering down our attempts.

Big questions remain, though: how do we minimise losses that might be considerable, given the lengths of pipe involved? Could we distribute at significantly lower temperatures (30°C) to reduce losses, but still enable higher CoPs from heat pumps stepping it up for end use? Can we afford to invest in high quality pre-insulated mild steel pipework to ensure longevity and limit leaks?

The transition to an ultra-low CO_2 output energy system is entirely possible and can be achieved quickly and efficiently by well-educated engineers making good decisions in the interests of society. But those decisions need to be made soon; we need unbiased input from the scientific community to guide this process, plus serious political leadership to instigate it and encourage community buy-in.

This might sound like an ambitious idea, but it is not the engineering that is the major challenge.

- This article appears as a blog on the CIBSE Resilient Cities website. For more articles like this please visit **www.cibse.org/Networks/Groups/Resilient-Cities**

GARETH YOUNG is a director at consulting engineer CDCE and wrote this article with the help of Inkling partner Susie Diamond

UPHOLDING A REPUTATION

Scotland is renowned for engineering excellence and this was in abundance at the sixth Technical Symposium, held at Edinburgh's Heriot-Watt University last month. **Alex Smith** and **Liza Young** report on some of the key papers presented at the event

> A morphology graph encourages a structural approach to creative design that maximises the skill sets of engineers and architects

Cooling the London Underground, and capturing heat from rivers and canals, were the subjects of the two best presentations at the 2016 CIBSE Technical Symposium, held at Heriot-Watt University in Edinburgh.

London Underground's latest research on keeping commuters cool on the Tube won the Best Presentation Award. Project manager Nick Boot-Handford gave a vivid description of the arduous conditions engineers faced when testing air handling units (AHUs) in an old 'ghost station' on the Piccadilly line. He described the spooky atmosphere as they tried to establish which unit was most resilient to the build-up of brake dust from the trains. 'Put it this way,' said Boot-Handford, 'I wouldn't want to be there on my own.'

Presenting with Graeme Maidment, Professor of air conditioning and refrigeration at London South Bank Unviersity, Boot-Handford described how engineers tested AHUs with and without filters, and with varying spacing between fins. TfL found the AHU with the largest space between fins and no filter, accumulated the least dust, because the weight of the build-up meant the dirt eventually fell to the ground rather than getting stuck between narrow fins.

A presentation on the *Surface Water Source Heat Pumps: Code of Practice*, by energy consultant Phil Jones (see news, page 8), won the prize for paper most likely to change the industry. He gave examples of the technologies used to extract heat from rivers, canals, lakes and coastlines, and said that engineers following the code will soon be able to get designs validated by a system of checks.

The annual symposium encourages academics and engineers to present their research to industry. More than 150 delegates attended the event, and more than 60 papers were presented on issues and technologies affecting building services engineers.

Communication was highlighted by the first speaker, Wim Zeiler, professor of building services at the University of Technology in Eindhoven. He saw a poster in an architect's office that read: 'Communication with the dead is only a little more difficult than communication with an engineer.'

Zeiler's paper was about integrated design, and how engineers should inform the work of architects at the conceptual design stage. 'We

Josh Bird, Stuart Allison and Alper Ozmumcu, of Arup

Phil Jones

can't leave it all to the architects. A lot of poor energy performance is due to their traditional thinking.' Zeiler advocated the use of a grid system – called a morphology graph – which encourages collaboration and a structural approach to creative design that maximises the skill sets of engineers and architects.

There was an excellent example of engineers being engaged at the start of the design process in a paper by Owen Connick, consulting manager, at Breathing Buildings, who described the hybrid natural ventilation system at Costa Coffee's new low-energy retail store in Telford. He showed how valuable post-occupancy monitoring was in optimising the system, which included a heat pump, underfloor heating/cooling, air conditioning and PV panels. (See 'Taking the grind of procurement', *CIBSE Journal Hotel and Leisure Special*, October 2015).

One unexpected finding was temperatures rising during the night because of the airtightness of the envelope, meaning heat from fridges stayed in the store. As a result, the underfloor manifold opened to provide cooling when temperatures reached 23°C.

Ashley Bateson, of Hoare Lea, presented the findings of the consultancy's post-occupancy evaluation (POE) of a mixed-mode ventilation strategy at Horizon House, in Bristol. He said the POE was carried out for no fee because the team was interested to see how well the design worked and whether occupants were satisfied. 'How can we continue to design without finding out how a building performs?' he asked.

Bateson said the stack effect was very powerful, almost sweeping paper off people's desks when the automatic doors were opening constantly during the morning rush hour. The survey also demonstrated the importance of an active facilities management team making salient interventions in the building.

Retrofitting was a key theme of the symposium. Rajat Gupta, of Oxford Brookes University, shared his findings after a council office retrofit, comprising internal insulation, secondary glazing and a new ventilation system. Gupta said the energy consumption of 245kWh · m^{-2} · year^{-1} was reduced by 58%, but main and specialist contractors working independently led to miscommunications. For example, the pre-cut insulation boards were not labelled, so the installers had to piece them together like a jigsaw on site.

New Nabers

Three presentations on the Nabers energy rating scheme attracted a full house. Nabers had been running as a voluntary scheme for 10 years when, in 2010, Australia's federal government mandated disclosure of base building operational energy performance on office space of more than 2,000m^2 net leasable area (NLA). Samantha Carlsson, graduate

SYMPOSIUM BEST BITS

The *CIBSE Journal* will publish some of the best papers in future issues. Next year's Technical Symposium will be held on 6-7 April, at Loughborough University, and more information will be published at **www.cibse.org/symposium** when it becomes available.

My symposium highlights

Sara Kassam, head of sustainability, CIBSE

As always, the CIBSE Technical Symposium – packed full of interesting people, subjects and discussions – didn't disappoint. The sheer richness and variety set my head spinning. Here are my highlights:

Alex MacLaren, Heriot-Watt University assistant professor in architectural design, and BSRIA senior consultant, Sarah Birchall, were fizzing with enthusiasm about collaboration, no doubt influenced by their own experiences of being involved in the BIM2050 Group. If creating a sustainable built environment is a collaborative endeavour, then surely we should be implementing more interdisciplinary learning, teaching, working and training?

Sadhbh Ni Hogain, Haringey Council housing retrofit manager, and University of Sheffield research associate, Rebecca Ince, provided an honest assessment of a large domestic retrofit project across six London boroughs. The 'smart advisor' role was found to be key in helping homeowners navigate the complex process of retrofitting, providing specialist technical advice and completing post-installation audits.

sustainability consultant at Hoare Lea, looked at the lessons Nabers has for the UK. She noted that four- to six-star Nabers buildings achieve a higher return on investment (ROI) than lower-rated ones, and suggested the same dynamic could catch on in Britain.

Ian Van Eerden, sustainability consultant at Northrop Consulting Engineers in Sydney, gave a first-hand account of the success of Nabers in driving energy efficiency improvements in new and existing office buildings. He identified the association between better energy performance and higher-quality working environments and active facilities management (FM) to explain why tenants are prepared to pay more for, and stay longer in, higher-rated buildings.

Verco technical director Robert Cohen explained how a Nabers-style Commitment Agreement might be introduced for new prime office base buildings in the UK. This is a formal contract in which a developer commits to achieving a specific post-construction, in-use base building energy rating (for which 12 months' operational data is required). In return, the developer may advertise the rating in advance of its measurement in use. This is of commercial benefit in Australia because many tenants seek, and pay a premium for, good Nabers ratings.

The Better Buildings Partnership (BBP) has agreed to pilot the scheme, hoping to design out the base building metering issues encountered in offices when it developed the Landlord Energy Rating in 2013. The pilot will involve about 10 studies over the next 18 months, and will test the key ingredients of the Commitment Agreement through their application to live projects (see news, page 7).

Several speakers looked at occupant comfort, with Sarah Noye, from Imperial College London, presenting 'Practical use of CO_2 sensors for early life-cycle energy and comfort'. She said a wireless CO_2 sensor network could give a snapshot of the real occupancy of a building, and data could be used to reveal occupancy rates via a qualitative algorithm, used in signal processing to detect anomalies in a noisy signal. Data should be collated over time to give an insight into occupancy patterns, which can then be used to inform the ventilation strategy.

Rod Bunn, of BSRIA, looked at whether buildings start out badly and get better over time, or start out well and degrade. He explored Building User Survey results from two buildings, in 1998, 2011 and 2015. A building that started out 100% cellular in 1998 and became open plan – while the number of staff doubled – 'tanked' in terms of occupant satisfaction. Bunn said: 'We spend too long looking at natural light and air quality, but not enough time thinking about the functional variables. Removal of things people value is detrimental to their perception of comfort.'

The symposium – sponsored by Cadline, Rinnai and Sefaira – shone a light on issues that can arise because of the imperfect structure of the construction industry. Andrew Corney, of Sefaira, asked why so many engineers are doing less early-stage HVAC sizing analysis, and relying on outdated rules of thumb. A survey by Sefaira revealed there was no financial incentive for carrying out accurate sizing at an early stage. Corney said most engineers have in-house modellers who focus on energy analysis, but they do not always trust the results. 'Most do their calculations in the second part of stage three, but, by then, plantroom sizing has already been established,' he said. **CJ**

● Read symposium papers at **www.cibse.org/symposiumpapers2016**

My symposium highlights

Owen Connick, consulting manager, Breathing Buildings

My favourite talk was by Sefaira product manager Andrew Corney. Energetic and enthusiastic, Corney posed an interesting question – why is no-one talking about HVAC sizing? The answer: because they're all using 'rules of thumb'. Work to be done in the industry here I think.

Phil Jones was very successful in engaging the audience during his talk on open water source heat pumps. It was a great mix of theory with examples. If a market exists for the technology, the potential is certainly there.

My presentation on lessons learned from the Hammerson/Costa eco-pod was well received and prompted loads of people to come and chat with me – which was the goal. So, on a personal level, the event was a great success.

Credit to the organisers; the evening at Edinburgh Castle was a lovely addition to a busy, highly engaging programme. See you next year!

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LEICESTER'S OTHER WINNING TEAM

The University of Leicester's Centre for Medicine is the largest project in the UK to gain Passivhaus certification. **Andy Pearson** looks at how outstanding teamwork between the contractor, engineer and architect ensured a winning scheme

If degree certificates were awarded for outstanding building performance, then the University of Leicester's Centre for Medicine would have graduated with first class honours. The new £42m building, which opened to students in February, includes a 1.6km-long ground-to-air heat exchanger, inter-slab cooling and a highly insulated and airtight building envelope. It also has the kudos of being the UK's largest Passivhaus-certified building.

The university commissioned the building to enable it to bring together the schools of medicine, health sciences and psychology under a single roof. It also wanted its new building to have very low carbon emissions to help the university achieve its ambition to be recognised for 'environmental and sustainability excellence'.

Accordingly, the university set its design team of engineer Couch Perry Wilkes and Associated Architects the challenge of designing a building that was inherently low energy in use to achieve an A-rated EPC and, perhaps more demanding, an A-rated DEC.

The team's response has been to design a 13,000m^2 building that is Passivhaus-certified. The scheme comprises a two-storey podium structure, which houses the main teaching spaces, both a 300-seat and smaller 150-seat lecture theatre, and informal learning spaces.

Three linked towers rise up from this podium; these contain a mixture of research laboratories, teaching spaces and cellular offices. Impressively, the scheme has an annual space heating demand of just 15kWh·m^{-2} and a total annual primary energy use of 116kWh·m^{-2} as defined by Passivhaus Planning Package (PHPP) – quite an achievement for a large academic building with variable occupancy that accommodates up to 2,000 students and 400 staff.

The PHPP spreadsheet was key to the scheme achieving Passivhaus certification. The tool proved invaluable in exploring alternative design solutions and enabling the design team to assess the outcomes of enhancing the performance of some construction elements. It could then offset this against less well-performing elements, to arrive at a design that optimised both performance and cost. In fact, one of the benefits of using Passivhaus on a large project such as this is that it increases the number of opportunities for construction variations, when compared to a small-scale Passivhaus scheme.

According to Stephen Ball, a director of Couch Perry Wilkes, the fundamentals of construction are not significantly different for a Passivhaus building of this scale when compared to any other Building Regulation compliant building; the key is in the detailing. 'We know that if we put in the correct amount of insulation to meet

the Passivhaus U values, we'll limit the building's heat losses. It is the detailing to limit thermal bridges, and to maintain an airtight barrier within the building fabric, that are critical to achieving Passivhaus energy targets,' he explains.

Preventing uncontrolled ventilation is one of the fundamentals of Passivhaus design. It was so critical to this scheme that Couch Perry Wilkes employed consultants HRS Services to peer-review the building fabric airtightness details and to pass comment on their effectiveness early in the design development. 'We were employing a second consultant to have an eyeball at what the architect had done to see if it was buildable to the Passivhaus regime,' says Ball.

Getting a contractor on board early in the design development was also fundamental to developing a buildable solution. The project, which was tendered as a two-stage design and build contract, was won by contractor Willmott Dixon working with low-energy building specialists and Passivhaus certification organisation Warm.

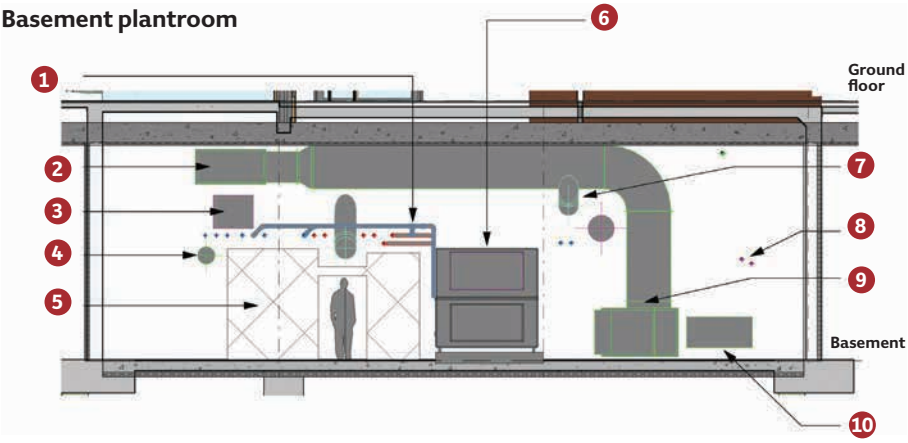
Willmott Dixon chose to construct the two-storey-high walls of the podium structure in line with the design team's original proposal. This was based on traditional masonry wall construction, complete with low conductivity wall ties and a 300mm cavity fully filled with insulation. Inside, the internal blockwork has been finished with a wet-applied plaster to provide an airtight solution. Between the masonry elements are infill sections of Passivhaus-certified curtain wall; these are sealed to the wall using specialist tapes and membranes to prevent any air leakage.

On the upper floors Willmott Dixon opted to swap the design team's proposed cladding solution of precast concrete sandwich panels for a curtain wall solution incorporating brick slip panels. This was because the contractor had concerns that

PROJECT TEAM

Client: University of Leicester
Architect: Associated Architects
Building services engineer: Couch Perry Wilkes
Air tightness consultancy: HRS Services
Passivhaus consultant: WARM
Structural engineer: Ramboll

Basement plantroom



Key
1 LPHW and CHW pipes serving heating and cooling coils within AHU **2** Intake bypass duct at high level within plantroom **3** Return air ductwork runs to riser **4** Dirty extract duct from high level fan runs to join exhaust **5** Air handling unit access and plantroom walkway **6** Air handling unit No. 1 (west block – ground and first) **7** Supply and extract ducts run beneath GAHE intake bypass duct **8** Underfloor heating/cooling pipework **9** GAHE intake bypass joins low-level intake duct **10** Main intake duct runs at low level within plantroom

> We were employing a second consultant to have an eyeball at what the architect had done to see if it was buildable to the Passivhaus regime – *Stephen Ball*

construction tolerances – and the need for movement joints – would have made it too difficult to achieve the required fabric airtightness. This solution also, conveniently, put the entire curtain walling system and responsibility for its airtightness and thermal performance, into a single subcontractor façade package. 'Willmott Dixon came up with a different cladding solution that allowed them to maintain the airtight line and improve buildability,' says Ball.

The change in façade construction was not without its complications; while the curtain wall solution was extremely airtight, it also required the addition of insulation internally to enable it to achieve a façade U-value of $0.13 W \cdot m^{-2} \cdot K^{-2}$ required by the Passivhaus Institute. Adding insulation internally, however, increased the risk of interstitial condensation, which meant additional seals and vapour control layers had to be incorporated.

The solution was clearly successful – when the building was pressure tested its pressure loss was $1 m^3 \cdot m^{-2} \cdot h^{-1}$ at 50Pa, well within the Passivhaus target. In addition, heavyweight internal partitions were added to the corridors to compensate for the lack of thermal mass in this solution.

With the fabric air losses minimised, fresh air is delivered to the building in a controlled manner using mechanical ventilation with heat recovery. Passivhaus places as much emphasis on ventilation and avoiding overheating during the summer as it does on keeping a space warm with minimal heating during the winter. Accordingly, the scheme includes a total of 10 air handling units (AHUs): five in the basement plant room, two in each of the two plantrooms situated on top of the towers, and one – supplying the main 300-seat lecture theatre – located in a dedicated plantroom beneath its raked seating.

All of the AHUs incorporate a thermal wheel to recover heat from the air before it is exhausted. In addition, the AHUs located in the basement serving the densely occupied teaching and lecture theatres, contain cooling coils to lop peak temperature during warmer periods.

To help reduce the primary energy demand by tempering the temperature of the incoming fresh air, the scheme incorporates a sinuous pipe labyrinth buried beneath the building and connected to the basement plantroom. This is arranged in what Ball calls a 'Tichelmann style' with large inlet and supply headers connected by rows of much smaller, 0.25m diameter, interconnecting heat transfer pipes. Air enters the labyrinth through air intakes concealed in colonnade lining the plinth façade. Silver particles incorporated into the heat exchanger's lining help inhibit bacterial growth.

The ground-to-air heat exchanger (GAHE) tempers all of the fresh air supply to the basement AHUs by pre-cooling it in summer and preheating it in winter. This fresh air supply of $34{,}200 m^{3} \cdot h^{-1}$ represents approximately 30% of the total fresh air entering the building. 'There is a significant amount of earth tube; even though it is not a prerequisite of Passivhaus, it makes sense to get the benefits of heating and cooling from the earth because the building is going to have mechanical ventilation throughout the year,' Ball explains.

Providing technical assurances of the energy savings expected to be delivered by the GAHE system to the Passivhaus institute proved to be quite a challenge, although once the occupancy profiles had been refined so that the demand for mechanical ventilation was known, the benefits became clear.

Equally challenging was weaving the heat exchanger ducting between the building's piles, drainage pipework and the tower

Shining a light

Couch Perry Wilkes also spent time developing a design that would maximise the amount of daylight entering the building to minimise the need for artificial light. 'Lighting tends to take a bit of a back seat with Passivhaus, which is more about heating and airtightness,' Ball says.

The consultant was helped in its endeavour by the narrow floorplates on the towers' upper levels and the full-height glazing, which allows daylight deep into the floorplates. 'All lighting is daylight-dimmed so that we have just the right amount of light in the rooms, which has a massive impact on primary energy demand.'

The scheme also includes Passivhaus-certified rooflights set into the roof of the plinth structure, to allow daylight into these deep plan spaces. 'We've used our lighting designers to develop a solution that goes way beyond what Passivhaus requires,' says Ball.

crane bases. The size of the building, and the subsequent volume of air that had to be delivered to ventilate it by the AHUs, was so high that there were limited options for Passivhaus-certified air handling units, and none available that had demand-driven controls.

'We were operating right on the margins of passing PHPP, so bespoke units had to be made, tested by BSRIA and clad in insulation to make them more efficient,' Ball says. Even so, because the units were without a Passivhaus certificate, the manufacturer's claimed efficiency had to be reduced by 12%. 'The AHUs are not Passivhaus certified so we had to take a hit under PHPP'.

Fresh air is delivered to the occupied zone via raised access floors with supply air displacement grilles throughout. Corridors and atria are utilised as the return air path for adjacent mechanically ventilated areas to improve the air quality in these transient spaces.

What Ball terms 'solar reservoirs' are located at the top of each atrium, where the heat energy will accumulate during the winter. This energy is extracted from the reservoir and transferred to incoming fresh air via heat exchangers in the AHUs.

During design development, the layout of the AHUs within the plantrooms was amended to minimise the lengths of the exhaust and intake duct runs, and to ensure all supply air distribution ductwork was contained within the envelope to reduce heat losses from the ductwork. It was also found to be beneficial to bring the rooftop plantrooms within the Passivhaus envelope to help limit the number of fabric thermal bridges and to improve their buildability.

Keeping cool

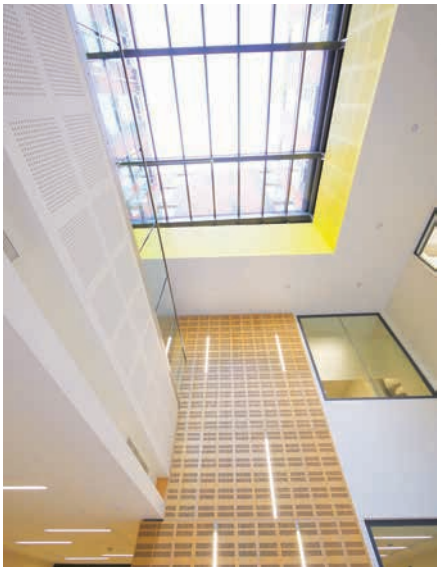
The building's high occupancy levels meant that limiting the internal temperature in the summer was one of the biggest design challenges. 'Because it is an airtight building, one of the issues with the scheme was getting rid of the heat in summer,' says Ball.

A three-pronged approach is used to tackle heat gains: firstly the thermal mass of the building's concrete frame and the underside of the floor slabs are exposed internally to help limit temperature fluctuations within the building; secondly, the heat absorbed by the thermal mass is removed at night by running the AHUs to recharge the thermal mass; and finally, the concrete soffits above the heavily occupied areas on the ground and first floors are cooled using a labyrinth of 7km of cooling pipework embedded in the slabs. The pipework is fed by chilled water from roof-mounted air-cooled chillers.

The chillers are connected to large chilled water buffer vessels located in the basement close to the cooling coils to reduce pump power. The buffer vessels are sized to maximise the benefits of the 'free cooling cycle' of the chiller plant. The vessels are charged and the system served (simultaneously) for the majority of the time entirely by the free cooling equipment without activating the chiller compressors. Annual space cooling energy demand is $1kWh \cdot m^{-2}$.

On the upper floors solar gains are controlled using mechanically operated roller-shutter type external blinds under control of the BMS. Fortunately the building's facades have proportionately less glazing than would be the case for a Passivhaus home. 'We've got about 33% glazing on the south (as opposed to 40-50% for a Passivhaus home) because we don't need the solar gain with all of the heat gains from people and equipment; the windows were mostly there for daylighting' says Ball. Even so, the blinds are necessary because the university has taken an egalitarian approach to staff accommodation by requiring each office to have an equally sized floor-to-ceiling triple-glazed window, regardless of orientation.

The blinds form part of, and are integrated into, the building's Schüco curtain wall system. They are constructed from narrow aluminium louvre blades, which provide shading while still allowing external views.



All images © University of Leicester

> Passivhaus places as much emphasis on ventilation and avoiding overheating during the summer as it does on keeping a space warm with minimal heating during the winter

Occupants also have the option of ventilating their rooms naturally in spring and on cool summer days. The triple-glazed windows do not open, but adjacent to the glazing is an opaque panel, which can be swung manually to reveal a louvred opening that will allow fresh air to enter the spaces.

'In winter the building is completely sealed and mechanically ventilated, but in the intermediate period occupants can open these panels like in any other naturally ventilated building,' explains Ball. When the room is being naturally ventilated, the BMS will turn off the mechanical ventilation.

Similarly, the BMS will also turn off the small radiator included in many of the rooms. The radiators have been included to enable the building to cope with extremes of occupancy during the winter. 'Because this is a building that may, or may not, have staff or students in certain rooms for long periods of time, there is no point in having a heating system that heats every space to the same temperature,' Ball explains.

He says the radiators have been sized 'just to take the edge off the room temperature'. The scheme also includes underfloor heating on the ground floor. Annual space heating demand is 15kWh/m². All space heating demand is supplied to the building from Leicester's district heating system.

The scheme also includes 115m² of solar PV in response to the need to achieve an EPC A-rating and meet the requirements of Leicester City Council's local plan.

The building was occupied in February. One of the biggest challenges with the move was in limiting the legacy IT equipment occupants could bring into the building, because it all has to be included in the building's Passivhaus primary energy consumption figure. It was a process made all the more complicated by the amalgamation of three departments, with three different ways of doing things, all of which had to be consolidated into a single solution.

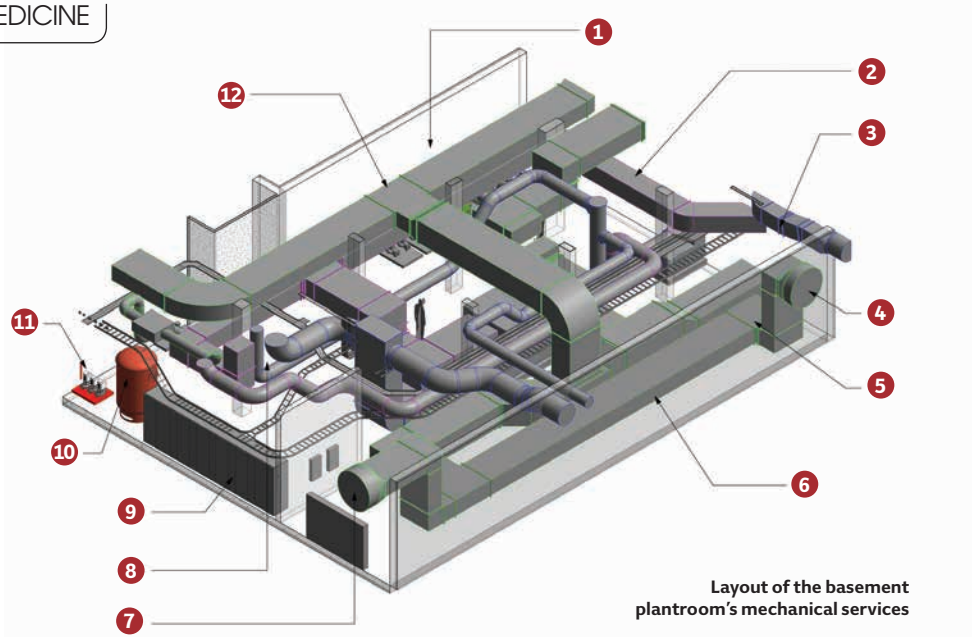
'We had to take a long run-up to explain to people that they would not be able to bring all of their old equipment with them – we started the process several years in advance,' explains Ball. The process must have been successful because annual primary energy consumption has been calculated at 116kWh·m^{-2}, just under the 120kWh·m^{-2} maximum permitted by Passivhaus Institute.

'This is another leap forward for Passivhaus in the UK; if you want to go down the Passivhaus route you have to start the design process really early on – which means designing a buildable, insulated airtight building and deciding on the equipment needs at the beginning,' says Ball.

What the actual energy consumption is remains to be seen. To help the university achieve its objective of an A-rated DEC, based on the actual meter readings of the occupied building, the design team and contractor have jointly committed to a three-year 'soft landings' period.

This should give the design and construction team time to fine-tune the building systems – and the university time to have communicated the benefits and constraints of occupying a Passivhaus building – so as to influence the behaviour of the building's 2,400 staff and students to help minimise their actual energy consumption.

'After one year we'll have the energy data to study and review,' says Ball. Watch this space. **CJ**



Layout of the basement plantroom's mechanical services

Key
1 Various plant sits against back wall within plantroom **2** Return air ductwork **3** Supply ductwork **4** Fresh air via GAHE intake ductwork enters plantroom and drops to low level **5** Concrete enclosures housing ductwork **6** Intake ductwork at low level **7** Fresh air via GAHE ductwork enters plantroom at high level **8** Supply and return ducts rise to above **9** LV switch panel **10** CHW buffer vessel **11** CHW pressurisation set **12** GAHE intake bypass ductwork

> Well aims to encourage healthy behaviour by changing the environmental cues that building designers provide for them

BUILDING WELL

The Well Building Standard is claimed to be the first evidence-based system for measuring, certifying and monitoring building features that impact on health and wellbeing. **Liza Young** explores its pros and cons

London's 22 Bishopsgate is the first project in the UK to be registered for Well Building Standard (Well) certification. The rating tool, administered by the International Well Building Institute in America, aims to give a single 'wellness' rating for buildings.

The standard puts health and wellness at the centre of design and construction decisions, in an effort to create more productive offices for staff. As well as forcing up the quality of buildings – where we spend more than 90% of our time – some experts believe the measure will raise the rental yield for property owners. But others, such as BSRIA's Rod Bunn, believe something as subjective as wellbeing cannot – and should not – be measured and distilled into a single rating.

Well Building Standard

A team at engineering consultancy Arup will be responsible for assessing and certifying 22 Bishopsgate, if planning permission for the building is granted. Ironically, the high-rise is embroiled in a right-to-light dispute, because occupants of neighbouring buildings are concerned their wellbeing will be affected by the amount of light the new construction will block from their buildings.

Well Accredited Professional (Well AP) Ann Marie Aguilar says the certification scheme is a game changer because, for the first time, wellbeing can be quantified and measured. The scheme, she adds, is informed

Facts behind the Well Building Standard

Well measures the attributes of a building that impact on occupant health by looking at seven areas – air, water, nourishment, light, fitness, comfort and mind.

The standard comprises more than 100 features, applied to each building project, that are categorised either as preconditions necessary for baseline Well Certification or compliance, or optimisations – optional enhancements that determine the level of certification above baseline.

The current Well v1 certification is optimised for commercial and institutional offices, and can be applied to three construction types: new and existing buildings; new and existing interiors; and core and shell.

PESHKOVA / SHUTTERSTOCK

by a seven-year programme of scientific and medical research, and peer-reviewed studies related to the impacts of the built environment on human health.

Well is the first to grant certification only after a building has been assessed in operation. 'Breeam and Leed projects must be designed sustainably, but – once in operation – many do not perform as designed. With Well, your building cannot get certified unless it meets all the performance metrics in use. This is a first for the built environment,' says Aguilar.

She says having multiple sustainability rating tools can often be frustrating, and Well has entered the market as an international scheme that aims to work with all the country-specific tools that can be issued for different types of buildings all over the world.

'The human body is the same in whichever region you build, so the information and medical research on which Well is based are consistent around the world.'

Well requirements

Well measures the attributes of buildings that impact on occupant health by looking at seven factors, or concepts.

One of these is nourishment – encouraging healthy eating habits by offering occupants healthier food choices, behavioural cues, and knowledge about nutrient quality.

Aguilar says: 'Nutrition is something architects and engineers are not typically responsible for in a building, yet it has a huge impact on people's health. Mindful eating, or healthier food choices, should be designed in, not thought about afterwards.'

As part of Well, designers need to meet with catering consultants to negotiate healthier options, she says, and encourage them to be transparent about the food they will be serving to the client and tenants.

Another concept covered by Well is fitness, and its requirements include supplying numerous opportunities for physical activity and exertion.

Aguilar says designers must encourage people to move through the building, and discourage them from sitting at their desks for prolonged periods. 'Stairwell design is another Well requirement – it needs to be an attractive place to walk through, with sufficient lighting and artwork. It's about changing people's behaviour so they choose the stairs rather than taking the elevator.'

Well aims to encourage healthy behaviour by changing the environmental cues that we, as designers, provide for them, she adds. It also ensures there's more interaction between human resources departments and facilities managers (FMs).

'Instead of waiting for the log book to show complaints from users, it's about working with them to prevent these things from happening, by engaging with employees,' says Aguilar. 'We have learned, through research, that elements such as lighting – which affects our circadian rhythm that regulates sleep patterns – air quality and filtration have a huge impact on how people feel. The less time people are sick will show the benefits of what we are doing.

'Well criteria are taking medical knowledge and infusing it with the built environment to come up with design solutions that ensure a healthier workforce.'

Hard to measure

In 2014, WorldGBC – led by a project team from UK-GBC – published the report *Health, Wellbeing and Productivity in Offices: The next chapter for green building*, which set out a framework for organisations to measure how buildings affect their employees.

WorldGBC then launched its follow-up campaign, Better Places for People, which applied these principles to other building types – retail stores and residential properties.

UK-GBC director of policy and communications, John Alker, says the study came from the realisation that 'we need to put the user back at the heart of the design

process'. 'Any one of those things can be influenced by outside factors,' he says. 'But if you measure them all together you're going to be able to spot trends.'

However, Bunn, principal consultant at BSRIA, says the link between wellbeing and productivity is tenuous at best, because neither factor can be measured accurately.

'The report is based on productivity guesstimates,' says Bunn. 'I've been in schools that tend to overheat in summer, yet their Ofsted assessment is outstanding. Human beings are known for being adaptable.'

Bunn says productivity is almost impossible to quantify because it can only be measured on repetitive tasks. 'If your company is not actually making anything, how are you going to put a number to that?'

He says evidence gathered in laboratory conditions is not a reflection of real life. 'You can change the air quality, air temperature and other environmental variables, and get a measured increase, or improvement, in mind or visual tasks. But a day in the real world has a great many more variations than the ones you can create in a lab.'

Towards accurate monitoring

Richard Francis, principal at The Monomoy Company – which has a methodology for assessing the relationship between building and business performance – says we are seeing more empirical measurements of wellbeing through technology.

Inventions coming from outside the built environment are changing the way we carry out research, he adds. Wearable technology – such as the Muse headband, which charts brain activity, stress and anxiety – will take measuring occupant comfort to the next level.

'You can take objective measurements – such as daylight, noise levels and air quality – with a smartphone or inexpensive IEQ monitor, and subjective measurements by asking how people feel,' says Francis. 'By combining these with physical objective measurements – people's heart and respiration rates, and brain activity – you're taking research out of the laboratory. People are beginning to make the connection that their environment has an effect on their life, and wearable technology is helping them to quantify and understand it better.'

Francis says real-time information streaming will take this even further. He cites the Reset certification, which assesses how building materials impact health. This uses cloud-based calculators and a global database of materials to stream indoor air quality data in real time. Another example is the Apple app for outdoor air quality, or Israel's BreezoMeter, which combines publicly available air-quality and weather data with algorithms, to provide hyper-local information in real time.

'No-one will want to buy a home when they know the area will have a detrimental impact on their health,' says Francis. 'Technology in people's pockets is going to make environmental-monitoring information public-facing, and open to future buyers and renters, forcing developers and communities to up their game.'

Well, or a similar tool, could create a 'nutritional label' for our buildings, says Francis. 'Something that says, if we provide this amount of daylight and this quality of air, it's likely to drive this level of performance.'

Occupant satisfaction

Bunn says there is a danger that clients may seek a consultancy service when all that is required is common sense. He says most buildings need a light-touch investigation. 'Whether you're designing or managing a building, look at it critically and be open about what the shortcomings might be; talk to the staff – that will get you 80% of the way there.'

Methodologies for understanding occupant satisfaction – such as the Building User Survey – are already out there, adds Bunn, and Soft Landings is the perfect way to get feedback on building performance in use.

Proving a link between wellbeing and productivity may be easier with the rise in popularity of wearable technology. But it remains to be seen whether Well will drive up performance or become the preserve of the high-end property owners who want a commercial advantage. If the plans for 22 Bishopsgate go ahead, we may find out. **CJ**

> Tech in people's pockets will make environmental-monitoring information public-facing, forcing developers to up their game

DENMARSH PHOTOGRAPHY

The Center for Sustainable Landscapes, Phipps Conservatory and Botanical Gardens, Pittsburgh – the first institution worldwide to be Well Certified Platinum

Looking beyond carbon reduction

The World Green Building Council (WorldGBC) is exploring the idea that behaviour can be influenced by context, and that an effective home design can improve occupants' health and wellbeing.

Ashley Bateson, partner and head of sustainability at Hoare Lea, is part of the UK-GBC task group looking into the issue. He says the study is a response to the government's Standards Review and the withdrawal of the Code for Sustainable Homes.

Ample academic research has shown that people feel more relaxed and less anxious in open green landscaping, says Bateson, and that people recover more quickly in hospitals if they can see green landscaping outside. He says North East housing association Gentoo has been issuing boilers on prescription to fuel-poor tenants to improve their health, and NHS costs in Sunderland have reduced as a result.

'This is looking beyond carbon reduction and energy efficiency, which engineers feel comfortable about,' says Bateson.

'Engineers and architects need to think about how they might manage the air quality or acoustics during an early site appraisal. Knowledge about how environmental factors affect occupants should be part of the analysis.'

ON A MISSION

Gareth Jones and Casey Cole are using big data to expose the real performance of domestic heat networks. **Alex Smith** finds out how their disrupter technology could see the industry adopting a Passivhaus-style target approach

Heat networks are the big nut to crack in the UK,' says Casey Cole, managing director of Guru Systems. He should know. His company has been monitoring 30 residential heat networks in the UK, and data has revealed a number of issues preventing their efficient operation.

'There is a whole lot of pain, from a whole lot of projects,' says Cole. 'We hadn't appreciated quite the extent of the problem until data from meter readings started to flow out of these sites. We then saw how bad the performance was on the majority of them.'

Casey Cole and co-founder Gareth Jones call themselves disrupters, and are using big data to challenge the 'business as usual' approach in the industry. The Guru Pinpoint data analysis software is exposing flaws in the design, installation and operation of heat networks, and its sister company FairHeat, where Gareth Jones is managing director, is using the analysis to help operators overcome issues by optimising the networks with a series of fixes, or 'interventions'. Cole is keen to point out 'the technology is not the problem'. He says good performance is possible and, with minor tweaks, performance can be dramatically improved. 'It's not about spending more on projects,' says Cole. 'You can spend less and get a better result.'

Government backing

It is a crucial time for heat networks in the UK. The government is backing district heating as a key low carbon source of heat, and, in the last Budget, £320m was committed to heat networks. It is a great opportunity for the industry, but the government will only stay faithful to the technology if it can prove it is a viable alternative to traditional sources of heat.

So what are the reasons for apparent poor performance uncovered by Guru Systems? Jones list his top five in the panel opposite. Issues such as poor commissioning, bypasses left open and absent pump controls are not new and Huw Blackwell spelled many of them out in his 'Foiling the great escape' article,

CIBSE Journal, August 2013. CIBSE and the Association of Decentralised Energy have also published a *Heat Networks: Code of Practice* outlining the issues and explaining how to optimise design.

Jones says part of the reason systems don't perform is because clients don't know what to ask for. 'Developers and housing associations are being forced into taking on the role of a utility company because of regulations or planning requirements. They didn't necessarily want to go down that route and they lack experience,' he says.

Cole believes there are two risks for landowners operating heat networks. First, there is a debt risk, where tenants may not pay for the energy and, second, the risk of hidden inefficiency in the system. So, if they have based tariffs on good performance and there are issues with operation, 'they can end up haemorrhaging money for a long time,' according to Cole.

Before creating Pinpoint, Guru Systems launched a pay-as-you-go billing platform that allowed operators and occupiers to see energy usage. It was when they checked the meters were working correctly that they discovered how many had been wrongly positioned or were not working. 'About 10% of the meters weren't reporting properly, or the probes were not put in, or were back to front,' says Cole. 'There may have been commissioning certificates, but they were worthless.' After they had been reinstalled correctly, the performance gaps in the systems became evident.

The pair found themselves 'soaking up time' explaining the issues to clients, which made them wonder whether a platform could be created to allow operators to interrogate data themselves.

'The idea was to shorten the time it takes to access data to seconds, so you can see how the system works immediately. We wanted to make it accessible for financial directors, facility managers and MDs,' says Jones.

The result was a web-based visualisation and analysis tool, which could accept data from smart meters, data loggers and BMSs. A DECC Small Business Research Initiative (SBRI) grant made it possible.

Key to the project is the inclusion of data from flats and plantrooms. As well as data on the volume of gas used by the power plant and power consumed by pumps, sensors for flow temperature, return temperature and flow rates in flats are included so that Pinpoint has visibility of any problem in tenants' properties, for example open bypasses or poorly commissioned heat interface units (HIUs), which are used to provide hydraulic separation at property boundaries.

Pinpoint lets interventions be loaded in the system, so it learns what the remedies are for root causes of inefficiency. It trains machine-learning algorithms to recognise patterns, and come up with possible interventions. Guru Systems has also included costs of interventions to help clients with decisions.

Opening up data

A big issue around collecting data was gaining the trust of operators who wouldn't normally share data for commercial reasons. The firm also had to made sure data taken from individual flats was secure.

Guru Systems asked the Open Data Insitute (ODI) to advise it on what should be kept private and what could be shared; *ISO27001 Information Security Management* was followed to ensure systems were protected.

'Data is so valuable that we can't risk personal data. We're being rock solid on this. Operators can participate without fear of giving away anything personal or sensitive,' says Cole. Client data sits on the platform but they can ask for it to be deleted at anytime.

The firm's commercial proposition relies on it offering Pinpoint to companies to help analyse their system data. Originally it had no intention of sharing data, but the ODI convinced it that it could share data of value to the wider industry without undermining its

Gareth Jones (left) and Casey Cole at their Borough Market office near London Bridge station

PHOTOS: SIMON WEIR

FAIRHEATS' KILLER ISSUES HURTING HEAT NETWORK PERFORMANCE

1. Open bypasses – it seems that every scheme we look at has bypasses left open somewhere in the network. Often these represent a significant portion of total network flows. As a result, return temperatures are much higher than they should be, leading to high losses and ancillary issues (such as inability to operate CHP)
2. Missing insulation, particularly on the terminal run from the laterals into the flat. This is a major contributor to losses and overheating in flats and corridors
3. HIUs not commissioned or poorly commissioned. In particular, DHW and/or space heating temperature set points are too high. This results in high return temperatures and, in some cases, can lead to the HIU effectively acting as a bypass in the system
4. Space heating return temperatures too high, typically due to poor (or non-existent) space heating circuit commissioning – for example, non balancing of radiator circuit. This results in very high return temps during space heating operation, with consequent impact on system performance
5. Poor (or absent) pump controls, resulting in pumps operating at full capacity. In combination with open bypasses, this can result in the whole network operating with close to a 0°C delta-T and very high pump electricity costs.

> Clients are desperate for measurable targets they can hold project teams to

commercial proposition.

The two pieces of data that underpin engineers' sizing calculations are peak demand per flat and the diversity factor (which allows for the fact that residents won't call for heat at the same time). The data is combined on diversity curves, and shows the results of 40 million real-time data readings across 2,000 dwellings (see Figure 1).

UK engineers can now compare their scheme to these diversity curves to ensure any system designs are sized appropriately. If the Guru curve is representative of heat network schemes in general, it suggests that the curve in the Code of Practice will need revising downwards. Engineers need to be very careful: not that their designs are capable or meeting peak load, but that they're capable of meeting the small base loads where the systems will spend most of their time.

Oversizing is the biggest and most common design problem for networks. This results in capital budgets being wasted on plant, pumps and pipework that are larger than necessary. It also restricts the peak efficiency of the resulting network for the rest of its service life. Oversized pumps can't modulate down to the low flow rates required, as they drive more water round the primary circuit and force up return temperatures. Central plant, unable to track low loads, will also charge in and quickly have to switch off, resulting in inefficient operation and spiky temperature outputs. Over-large pipes in an oversized system will also lose additional heat.

Guru Systems piloted Pinpoint on three projects, including a 115-unit housing association scheme. A survey of the data revealed mid-level losses, and 70% were found to be from the corridor to the HIUs. It was found that the flow and return had similar losses, when the return should have been lower. The problem was a lack of insulation on pipework leading to the HIU – the terminal branch – and faulty HIU valves, which were damaged by high flow rates in the system caused by oversized pumps. After rectifying the issues, network losses were reduced by 68% and the tariff cut from 7.7p to 3.8p per kwh. Once the terminal branch was insulated, corridor temperatures also fell. The cost of interventions had a two-year payback.

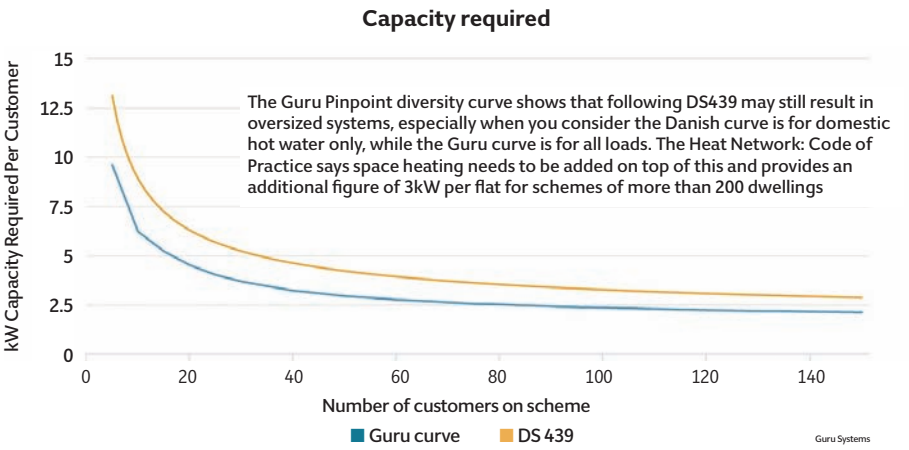


Figure 1: Guru diversity curve compared with *Danish DS 439 Code of Practice for domestic water supply installations*

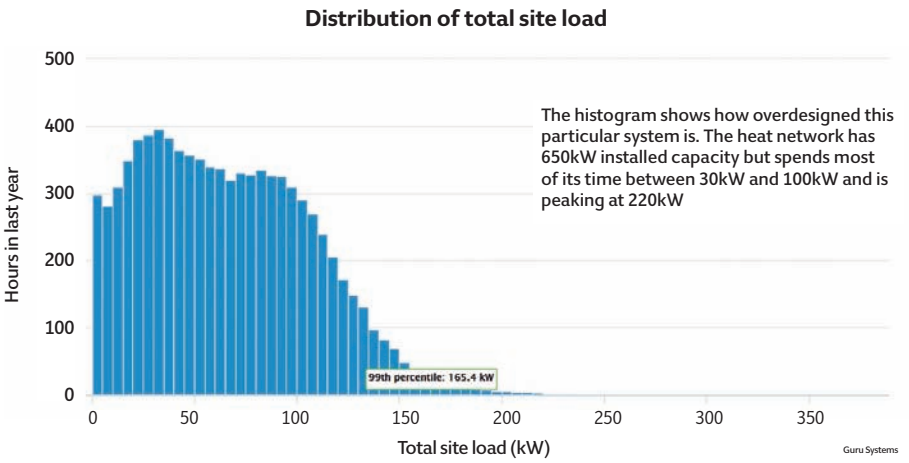


Figure 2: Load histogram for a site with 650kW-installed capacity

Setting a standard

FairHeat is now working with CIBSE and ADE to incorporate metrics into the *Heat Networks: Code of Practice*. These have been derived from measurable targets developed by FairHeat for its clients.

'There is a precedent in Passivhaus, as everyone knows what has to be achieved; you pass or you fail,' says Cole. 'We have a performance gap in services – we are addressing this gap in district heating.'

The performance metrics have been handed to CIBSE and ADE, and could be incorporated in the Code of Practice to check the heat network at every stage of the procurement process from feasibilty through design to the commissioning phase.

However, there is a long way to go before measurable targets based on real data can be drawn up for the entire industry. Non-domestic district heating schemes are not yet being measured, nor is the pipework in the street. Jones and Cole are keen to do the work.

They are both optimistic targets will be incorporated into the Code of Practice and work the same way Passivhaus has in eliminating performance gaps. Jones believes the commercial imperative will drive change.

'Projects held to measurable targets actually work better and cost less,' he says. Up until now, Jones says, there has been no commercial incentive to design, install and build systems that perform well. 'Now clients are desperate for measurable targets they can hold project teams to'. **CJ**

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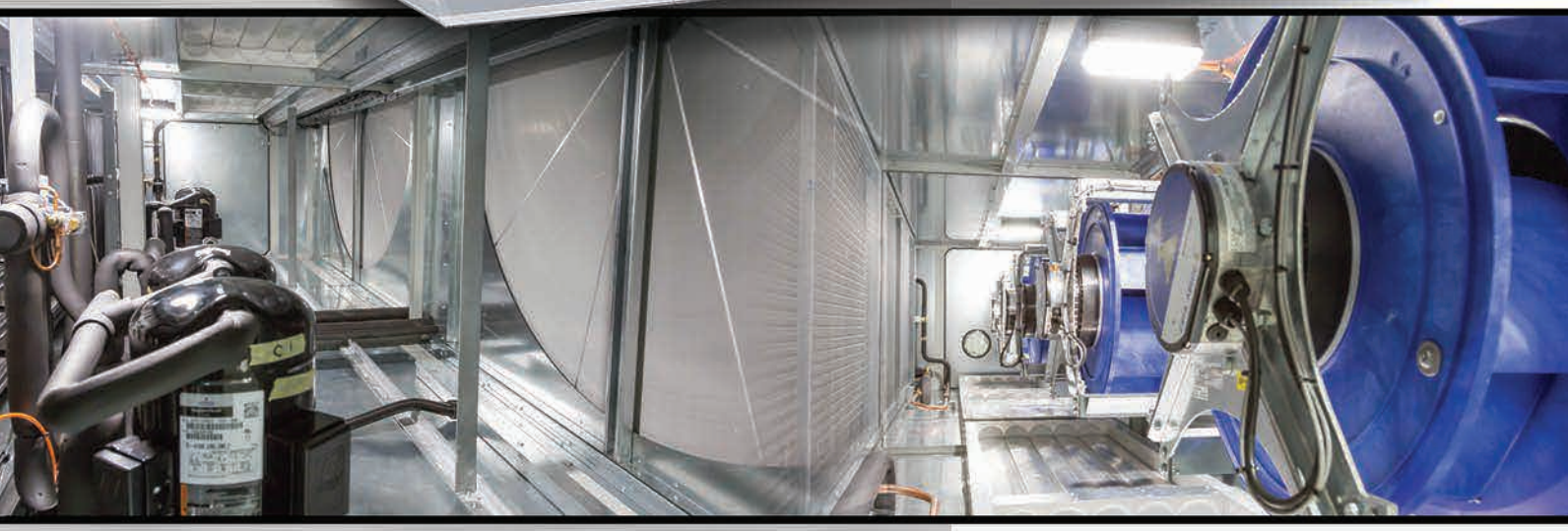

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This month: The vernacular of ventilation, Ecodesign directive for ventilation units and services at the Victoria and Albert Museum

AIR OF CREDIBILITY

Widespread confusion over terms used to describe the geometry of ventilation openings has inspired a paper by **Benjamin Jones**, **Malcolm Cook**, **Shaun Fitzgerald** and **Christopher Iddon**

During a recent CIBSE Natural Ventilation Group event, a discussion began about ways to help engineers describe the geometry of windows that allow a specific airflow rate. While one colleague was clear that a cross-sectional area should be considered, another was adamant that it should be a geometric area, and a third was sure that it should be an aerodynamic area.

We soon realised that although the output of any modelling might be the same if the different areas were treated appropriately in the model, we hypothesised that this was a significant source of potential error.

Our discussion led to a wider review of the terms used to describe ventilation opening areas as they appear in more than 50 papers, books, standards, guidelines, and the manuals of software tools[1]. It showed that there is widespread confusion over these terms, and this article summarises of the published paper that, we hope, gives clarity on the terms used to describe ventilation opening areas.

Geometry and resistance

Ventilation is exchange of air between a building and its local environment. It occurs simultaneously through openings that have been both designed and not designed.

We are particularly interested in those that are designed by architects and sized by engineers. It is the responsibility of the ventilation engineer to establish the size and location of all openings. Both factors depend on the airflow rates through each opening needed to maintain adequate indoor air quality, and to dissipate heat gains under extreme environmental conditions.

Descriptions of the geometry of each opening and its resistance to airflow are required, so that the performance of a system can be established using a modelling tool. An incorrect interpretation of these parameters can have serious consequences, such as the inadequate airflow through a space with consequent overheating and/or air quality issues, or ventilation openings that are oversized and, therefore, too expensive.

Ambiguity problems

The vast majority of ventilation openings in buildings can be described as sharp-edged.

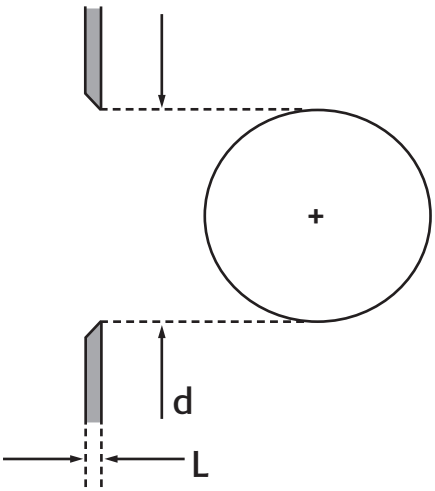

Figure 1: A sharp-edged orifice

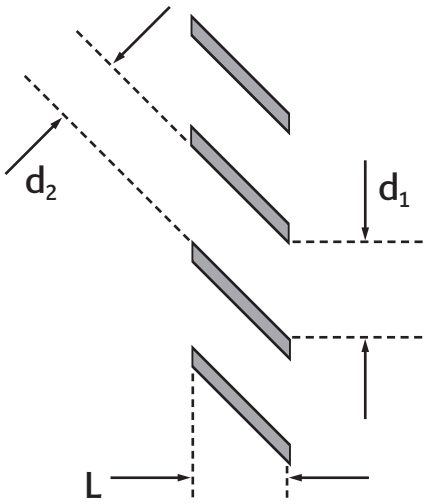

Figure 2: Ambiguity in opening-free area

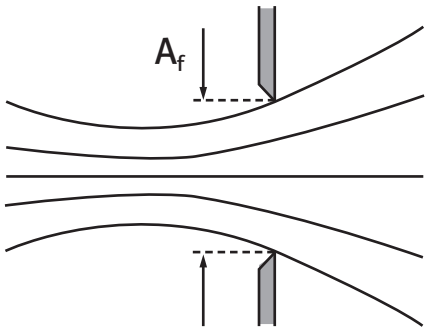

Figure 3: Streamlines through a sharp-edged orifice

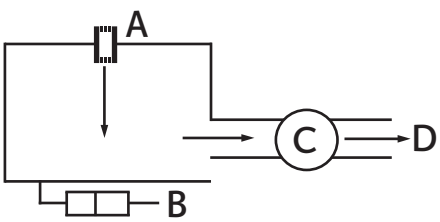

Figure 4: Test chamber. A – ventilation opening; B – anemometer; C – flow meter; D – airflow to fan[2]

This means they are thin when compared to their circumference. Figure 1 shows a perfectly round hole in a thin sheet of metal, known as an orifice, with a thickness L (m).

It is very easy to establish the diameter, d (m), of this opening using a set of calipers, and to identify it as sharp-edged when $L/d < 2$. It is also easy to calculate its area and, although there would be very few arguments about this metric, there may be some about its name. We propose that this area should be known as a free area because it identifies the area free from obstruction; in some sources it may also be known as a cross-sectional, measurable or geometric area, which should be avoided.

What about more complex openings? Figure 2 shows a louvered opening where two possible lengths could be used to calculate a free area. Either can be correct, so long as the appropriate equation is used and workings are clearly presented. However, this ambiguity makes a free area a problematic metric because it has the potential to introduce error into the design process. We think an alternative is required.

Towards parsimony

The airflow rate, Q (m³/s), through any sharp-edged opening is proportional to its free area, Af (m²), the pressure drop across the opening ΔP (Pa), the density of the air p (kg/m³), and the shape of the opening, so that

1)
$$Q = C_d A_f \sqrt{\frac{2\Delta P}{\rho}}$$

Here, C_d is a dimensionless discharge coefficient that accounts for the constriction of streamlines after flow passes through an opening (see Figure 3).

Accordingly, it is a positive number of less than 1. A discharge coefficient, C_{d_o}, of the standard circular sharp-edged orifice, shown in Figure 1, is often – but not always – given as $C_{d_o} = 0.61$. For sharp-edged openings with a fixed free area, such as a vent, the C_d can be considered constant in most cases. Then A_f and C_d can be combined into a single term, known as an effective area, A_{eff} (m) where

2)
$$A_{eff} = C_d A_f$$

Another approach is to calculate the equivalent area, A_{eq} (m), of a hypothetical circular sharp-edged orifice that allows air to pass at the same volume flow rate as a ventilation opening with area, A_f, at an identical pressure difference, where

3)
$$A_{eq} = \frac{C_d A_f}{C_{d_o}} = \frac{A_{eff}}{C_{d_o}}$$

However, this process could introduce uncertainty into the value of A_{eq} because there is no standard value for C_{do}. Accordingly, we believe that an effective area, A_{eff}, is the most parsimonious metric that has the least uncertainty in its value.

Measuring effective area

The effective area, A_{eff}, for a specific ventilation opening is measured using a standard test rig (see Figure 4) described by EN13141-1. It comprises a sealed chamber to which an opening is attached, a fan, a long duct and an anemometer. The A_{eff} is measured under still external air conditions with uniform density so that the airflow through the opening is exclusively generated by a fan. The flow rate, Q, is systematically varied and ΔP is recorded at each interval. A_{eff} is determined by regression using Equations (1) and (2).

Problems with existing terms

There are many documents that do not define terms, assign multiple terms to a definition, or a single term to different definitions. Some contradict themselves. For example BS5925 defines the term 'equivalent area', but also uses the undefined term 'effective equivalent area'. This is potentially confusing, especially if one is aware of differing definitions of effective and equivalent areas given by Equation (3).

Progress and best practice

Missing or contradictory definitions of opening area can lead to errors in practice. We propose that standards, guidelines and software tools should use an effective area, A_{eff}, defined by Equation (2) as their default description of an opening area. Manufacturers should give A_{eff} as standard and designers should stipulate this in their designs. Guidelines and standards should recommend that manufacturers provide A_{eff} as best practice. These steps will reduce design errors and lead to successful natural ventilation strategies – and better buildings. **CJ**

References:

1 Jones BM, Cook MJ, Fitzgerald SD, Iddon CR. A Review of Ventilation Opening Area Terminology. Energy and Buildings, 2016, 118: 249-58.

2 Etheridge DW, *Natural Ventilation of Buildings: Theory, Measurement and Design*, John Wiley and Sons, 2012, 11.2: 343.

● **DR BENJAMIN JONES** is an assistant professor at the University of Nottingham, **PROF MALCOLM COOK** is a professor at Loughborough University, **PROF SHAUN FITZGERALD**, FCIBSE, is a visiting professor at the University of Cambridge and **DR CHRISTOPHER IDDON**, MCIBSE, is a design manager at SE Controls

THE ECODESIGN BIAS AGAINST VENTILATION UNITS

Ventilation units are being unfairly penalised in a European directive. Renson's **Yves Lambert** says designers will have difficulty specifying these systems unless the EU creates a level playing field

Ecodesign is supposed to be an effective tool for improving the energy efficiency of products.

It should help eliminate the worst performing products from the market, significantly contributing to the EU's 2020 energy efficiency objective.

Recently, Ecodesign has extended its scope from household products to the technical building systems. But, is the Ecodesign procedure capable of correctly assessing technical building systems?

In this article, we will prove that there are serious problems that need to be addressed in the case of the Ecodesign directive for ventilation units (Commission Regulation 1253/2014 & 1254/2014).

The first point to bear in mind is that technical building systems, such as ventilation, are not stand-alone. They need to be designed, installed and maintained correctly to achieve the energy efficiency published by the manufacturer. They are not household appliances such as TVs, where the energy performance will be the same whether they are placed in a living room in London or Berlin.

Not all ventilation systems are covered in the extended Ecodesign. Intermittent extract fans <30W are considered 'out of scope' for labelling (only information requirements) because of 'the scarce additional energy saving achievable compared to the administrative burden for the market surveillance'. This conclusion is questionable, because installing four or more of these <30W units in a house could represent a higher energy consumption than a centralised ventilation unit.

Since the Ecodesign methodology focuses on electricity consumption, passive stack systems are considered out of scope. This means that passive stack can never obtain a label, contrary to alternatives like unidirectional ventilation units (UVUs or MEV) or bidirectional ventilation units (BVUs or MVHR). In the world of consumer products the absence of a label can be overcome, but technical building products are specified.

If it is specified that the ventilation system to be installed must have a B label or higher, then passive stack suppliers cannot compete. This is a clear discrimination and goes against the 'technology neutrality' principle, which means no legislation should discriminate or block a certain technology.

Heat recovery systems

The final joint text took into account input from relevant stakeholders – including manufacturers and their associations, environmental NGOs, and consumer organisations – and ensured a similar energy performance for MEV with demand control

and MVHR. But, during the final vote of the regulatory committee, the best reduction factor for demand control – 0,5 – was deleted on request of one member state. Consequently, BVUs can maximise the theoretical efficiency of the heat recovery while demand control is not allowed to use its full potential (maximum 0,65 reduction).

Translated into labels, BVUs can reach an A+ label, while the best UVUs with demand control can, at best, reach a B-label. This situation gives a competitive advantage for MVHR, thus going against the Ecodesign principle that says: 'Ecodesign should avoid a distorted competition'.

No differentiation

Although everybody knows that heat recovery efficiency is very different in a cold climate compared to a warm climate, it was decided that the energy label would only be representative for an average climate because a 'climate zone is not a product feature and there is no possibility of checking compliance of the product placed on the market'.

This means that, according to the Ecodesign label, the energy performance of a ventilation system is the same for the north of Sweden as it is for the south of Italy. So energy saving will be underestimated in Sweden and overestimated in Italy.

Many of the standards required for the measurements and calculations are currently under revision and should be ready by mid-2016. To overcome this problem, the EC published the document *Transitional methods of measurement and calculation*. Although a good effort, the document contains provisos like 'freedom is left to the manufacturer…'. This kind of vagueness will inevitably damage the European ventilation industry's image. By ignoring so many facts about ventilation performance, BVUs will be considered the best solution, leaving alternatives – like passive stack and MEV – without defense.

Clearly, energy labelling for ventilation units has serious issues to resolve before it becomes technologically neutral. An early revision of the Commission Regulation 1253/2014 is urgently required before real damage is done to the ventilation industry. **CJ**

YVES LAMBERT is the public affairs manager at Renson

ANDREI TARCHYSHNIK / SHUTTERSTOCK

The renowned galleries of the Victoria and Albert Museum play an essential role in protecting the priceless artefacts on display. **Andy Lerpiniere** explains how Arup met the museum's brief by designing a system that minimised the amount of cooling and humidification required

A LIGHT TOUCH

Designing museum or gallery spaces is, Arup believes, a combination of art and science. When embarking on a project, we look to create the best possible environment for experiencing exhibits, and for preserving these from damage and deterioration. This involves the careful consideration of several factors, from the general design of the building and the way visitors move around it, to the temperature, humidity, air filtration and noise levels within specific galleries.

Breaking from tradition: working with the V&A

Historically, the approach to gallery and museum spaces has been markedly conservative; housing objects in glass cases, in low-lit rooms, was felt to be the safest way to prevent their deterioration.

The approach taken by the Victoria and Albert Museum (V&A) in London is far more nuanced and sophisticated, however. Its exhibition teams work on the basis that every collection is different and should be treated accordingly.

One grounding concept in our work with the V&A is the understanding that avoiding rapid environmental fluctuations is key. One approach to environmental conditioning is to maintain tightly controlled temperatures and humidity. We believe that these conditions do not have to be so closely regulated, as long as a constant environment is maintained. Fluctuations in temperature and humidity pose a far more aggressive threat to the preservation of the majority of objects and artefacts than either high or low humidity.

If it is believed that a wider band of temperature and humidity is acceptable, the possibility of taking a more passive approach to controlling environmental conditions within galleries becomes far more realistic. This takes into account the mass of the building and uses this – combined with heating and ventilation – to control humidity. This is preferable to using energy-intensive, active systems to control gallery humidity directly.

Attempting to reach an agreement with

> The strategy reduces energy costs and enables the museum to continue challenging convention around gallery design

museum teams to take a more passive approach where possible was ambitious. We used software to analyse gallery conditions and predict how environmental changes would affect objects in those spaces. We then had a series of conversations with the V&A directorate to outline our findings.

Once we had allayed its concerns that objects would be adequately preserved, the V&A was incredibly supportive. After all, the strategy reduces energy costs significantly and enables the museum to continue challenging convention around gallery design and appropriate solutions.

We have worked with the museum for more than a decade now and, during this time, have collaborated to refine our approach to environmental conditioning.

Our approach to environmental conditioning

We developed a strategy that controls ventilation by moisture content in the V&A's Medieval & Renaissance galleries. The control system constantly compares internal and external air-moisture levels, and fresh air is introduced when the humidity levels are either too high or too low. The fresh air is only drawn in when moisture levels are appropriate, so this makes a positive difference to the ambient humidity. We verified the strategy by undertaking detailed analysis of the conditions that might occur in the gallery over the course of a year. This indicated that the system would remain compliant with the museum's and conservators' requirements.

This approach was incredibly successful. It required less capital investment in terms of mechanical equipment, while the omission of cooling and humidification controls led to a 30% reduction in energy consumption, compared with similar galleries.

As a result, we developed this further – with architects ZMMA – for the V&A's Europe 1600-1815 galleries. For these, we had to take into consideration the specific needs of several objects on open display, many of which are made of wood, an organic material particularly sensitive to fluctuations in relative humidity.

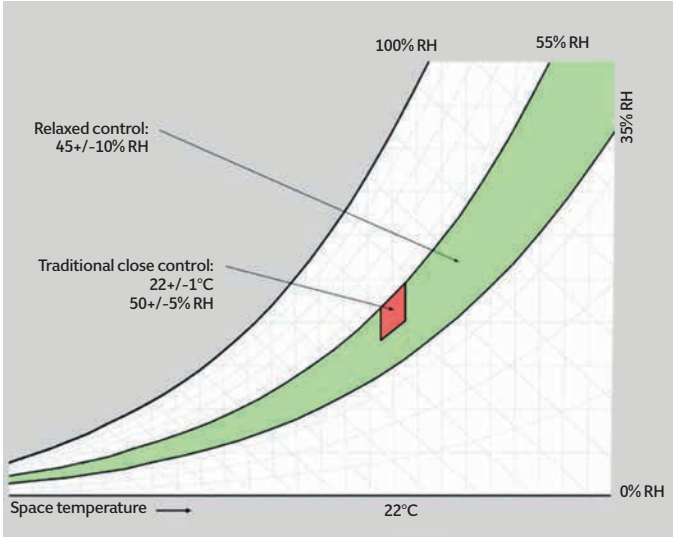

Figure 1: Traditional gallery control has been based on tightly controlling temperature and relative humidity (the red zone). Arup's approach at the V&A has been to allow temperatures and relative humidity to vary over a much wider range (the green zone)

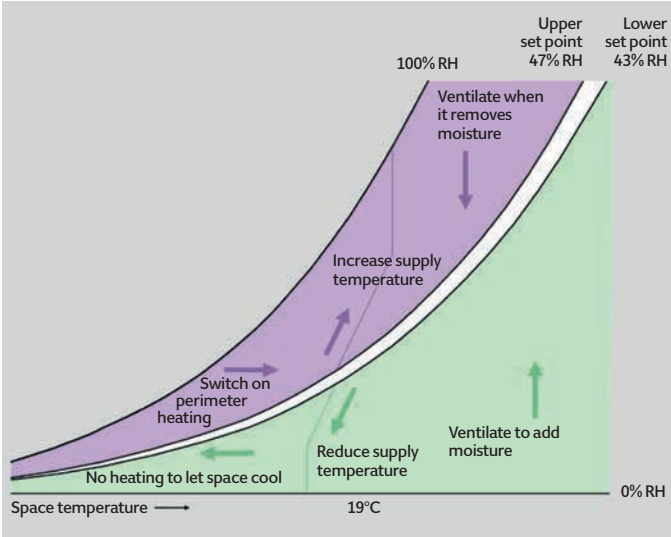

Figure 2: The control system responds to internal and external conditions to ventilate or heat the space to drive the internal environment towards the relative humidity set point

> Our objective was to create solutions that are simple to operate and maintain, and that the museum can afford to keep running

During winter, cold snaps that last for more than a week can significantly reduce relative humidity within the galleries. Conservation teams were concerned about the impact of these conditions on wooden furniture, so we worked closely with them to agree an absolute limit on low relative humidity. To ensure this could be met, we provided limited humidification equipment, which will only activate if critical internal conditions are reached.

Achieving environmental stability was further complicated by some of the galleries being south-facing, which means they are more susceptible to fluctuations in sunlight and temperature because of solar gains.

Many of the galleries contain ornate waxes that are very sensitive to high temperatures, so it is imperative that these do not overheat. To avoid this, we have installed a cooling connection as a last-resort solution, which will activate if the waxes are at risk. In addition, the galleries have blinds to control sunlight and consequent solar gains.

Environmental monitoring: The relationship continues

Another aspect of Arup's work on the Europe 1600-1815 galleries is that the V&A has granted us remote access to its building management system (BMS). This allows us to log conditions every 60 seconds and to monitor the plant for a real-time view of how the system is performing.

When the plant was being commissioned, we were able to check and test the systems in real time to ensure they were performing as required. We were able to identify anomalies incredibly quickly, and work to rectify these before the conditions created could adversely affect the objects on display.

We achieved a successful handover to the V&A a week before the galleries were opened to the public – a notable achievement on any museum project. Now that we are operational with this sophisticated monitoring system, checks are more timetabled. Any changes in weather – such as the cold snaps or prolonged periods of rainfall that we have experienced this winter – will have a direct impact on how the system works.

Working within building limits

This project was made more challenging by the requirement to work within the existing

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historic building fabric. We overcame this by threading services through the original building, using existing trenches and disused ventilation chimneys, to keep equipment hidden.

The V&A and ZMMA both wanted the galleries stripped back to expose the beauty and simplicity of the original architecture; our sensitive approach has enabled this aspiration to be met, and has achieved a high-quality finish that focuses attention on the objects and artefacts.

More than a simple refurbishment, this project involved carving out and stitching together new spaces within the existing museum. One way we achieved this was by elevating a building services plantroom from floor level onto a mezzanine, enabling a new gallery to be formed below.

We also incorporated the building's original ventilation tunnels into designs, allowing these to deliver fresh air to the galleries. This fed into our overall objective: to create appropriate solutions that are simple to operate and maintain, and that the museum can afford to keep running.

A successful collaboration

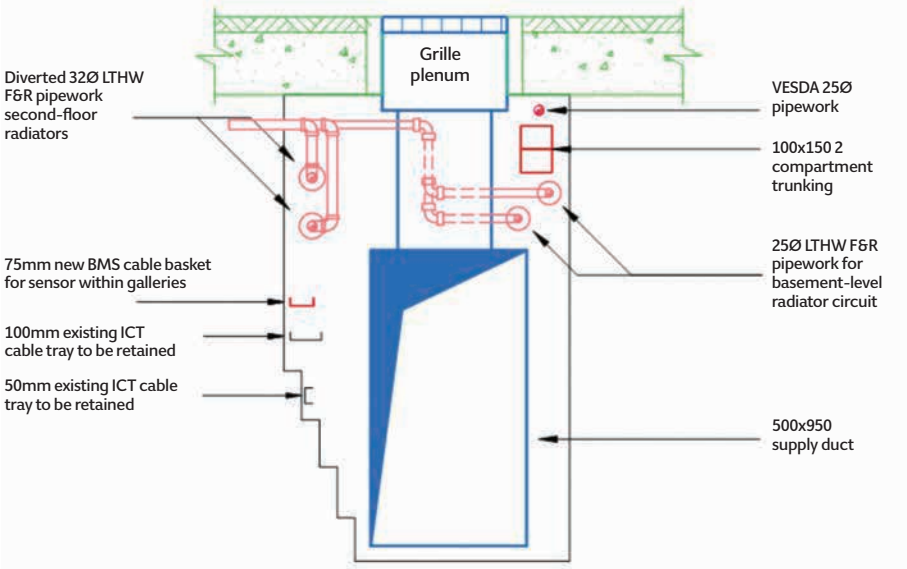
Creating a services strategy that integrated seamlessly with the building fabric and new architecture demanded close collaboration with the V&A and ZMMA.

It is critical when starting any project to try to understand the architectural approach and the desired intent; this helps to set and inform the parameters of the project. We discussed our approach in detail with ZMMA, before and during design, and quickly raised points where we felt the services may have an impact on the architecture. In all cases, we were able to find solutions through open discussion.

In the Europe 1600-1815 galleries, ZMMA was responsible for the architectural and exhibition design. This was very beneficial because this architectural vision enabled the engineering team to understand how our design would affect the look and feel of the galleries.

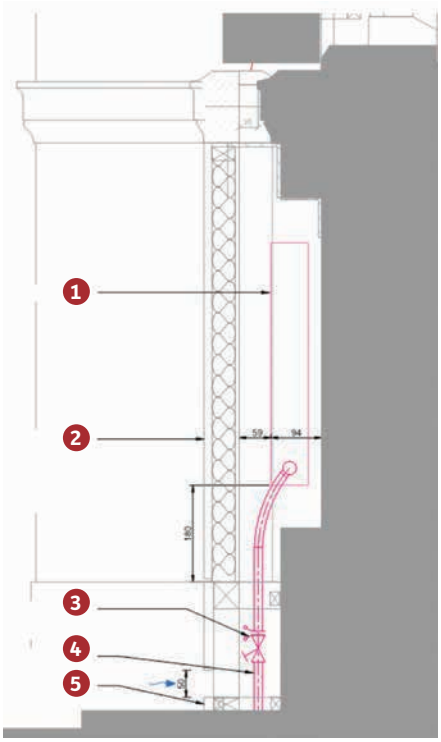
I have little doubt that passive environmental controls will become increasingly mainstream in our engineering designs for museums and galleries. Working with the V&A, we sought to set ambitious standards for these, to ensure the preservation of priceless, historic objects, and to support the industry's aim of reducing energy consumption and meeting laudable sustainability targets. **CJ**

Section of an original trench used for primary services



Accessible trenches at the perimeter of the galleries contain all primary services. They were originally used for ventilation, and subsequently for carrying data cables

Section view of radiators



1 Wall-mounted radiator

2 Baffle to protect close artefacts from radiant heat and thermal cycling. Double-skin baffle construction with insulation to prevent energy transfer and emission towards artefacts

3 Low flow commissioning valves and radiator pipe connections in skirting boxing

4 15Ø LTHW fan pipework from service trench below

5 Boxing out to conceal valves and pipe connections. To be installed following system commissioning and witnessing

Visible services such as radiators, have been coordinated with the original building architecture

> It is critical to understand the architectural approach and the desired intent; this helps to set and inform the parameters of the project

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Assessing and improving the acoustic performance of soil and waste pipes in buildings

This module considers how to reduce the unwanted noise in buildings that can be spread by soil and waste pipework

The use of plastic waste pipes is widespread in waste and soil systems for domestic, commercial and industrial buildings. In the majority of installations, this has usurped the rigid and heavyweight – and formerly, ubiquitous – cast iron pipework. The ease of installation of lightweight plastic materials, using simple push-fit or solvent-welded connections, enables a convenient and comparatively low-cost installation. But in some circumstances, the very lightweight construction that makes it popular can also result in it spreading unwanted noise to occupied spaces in buildings.

This CPD will consider the factors that may be used to assess and improve the acoustic performance of plastic soil and waste pipes.

In the UK, the sizing and piping arrangement for soil and waste pipes should conform with BS EN 12056-2:2000 *Gravity drainage systems inside buildings*, as referenced by the building regulations and standards. Waste pipes – typically, nominally 32, 40 or 50mm diameter – carry water discharged from sanitary appliances (such as basins, sinks, showers, baths and urinals) into the main soil pipe, or 'discharge stack'. The soil pipe (so named after the euphemism 'night soil') – typically of outside diameter 110 or 160mm – often combines foul water from WCs with that from other appliances, and passes through the building, eventually to connect with a sewage system. Additionally, the building regulations and standards (including AD Part E[1] of the England Building Regulations) make provisions to ensure that the acoustic performance of above-ground soil and waste systems is properly considered.

As discussed in CIBSE Guide G 2014 *Public health and plumbing engineering*, the location, intended use and occupancy of the space are all relevant to the acoustic performance. If the space is to be used as, for example, a car park the acoustic treatment is likely to be limited to materials selection. However, for more sensitive areas – for example, offices, study/quiet areas, domestic and hotel applications – more effective treatment will be required, such as using building mass, sound insulation, architectural (appropriately constructed) ducts or pipework that is manufactured and installed to produce less noise. Assessing the potential effect of noise on building occupants often requires the specialist analysis of an acoustics expert. However, building services professionals will benefit from some key knowledge of the parameters that define the acoustic environment, so that they are better able to interpret acoustic data and the performance of services systems.

Acoustic parameters

The actual strength of a particular sound felt by the ear is related to the sound pressure, p (Pa), – this is the amplitude of the sound wave, and to accommodate the range of ambient sound pressure levels, logarithms are typically used to represent the ear's response to sound. The 'Bel' is given by the log (to base 10) of the ratio of two quantities – for example, two comparative sound pressure levels. The 'deciBel' is a tenth of a Bel, and provides a more usable scale. The human ear responds to sound intensity I, where $I = p^2/\rho c$ and ρ is the air density ($kg \cdot m^{-3}$) and c is the speed of sound ($m \cdot s^{-1}$).

Since intensity varies with square of sound pressure, the sound pressure level uses a ratio of the square of the sound pressure to provide a usable and relevant metric for sound pressure. So,

$$\text{Sound pressure level, } Lp = 10 \log_{10} \frac{\text{sound pressure}^2}{(\text{reference sound pressure})^2} \text{ decibels (dB)}$$

$$= 20 \log_{10} \frac{p}{p_{ref}} \text{ decibels (dB)}$$

and p_{ref} is the pressure at the lower end of human audibility 2×10^{-5} Pa (or 20 μPa)

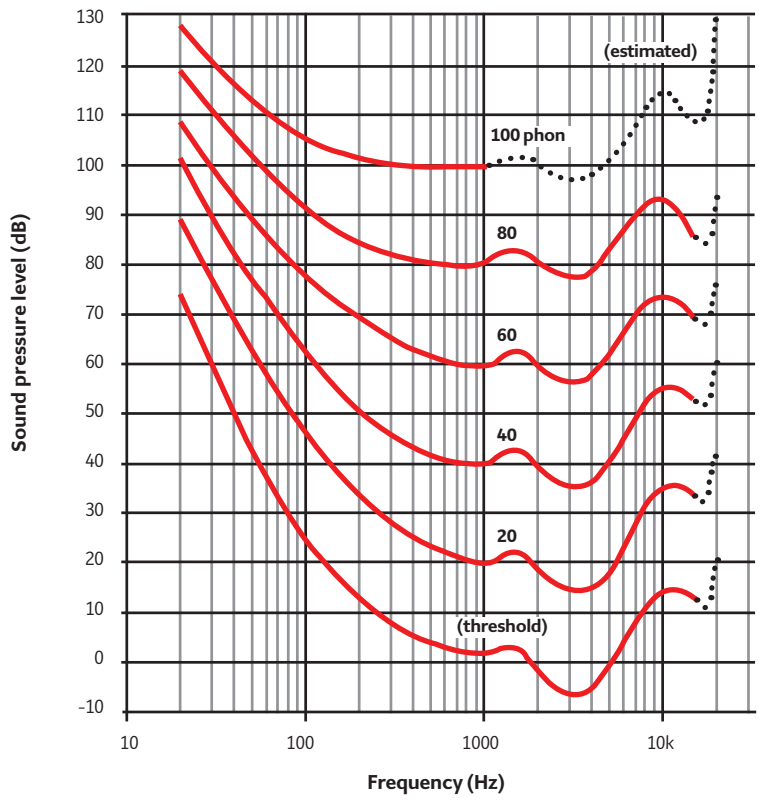

Figure 1: Phon – equal loudness contours (Data source: ISO 226:2003)

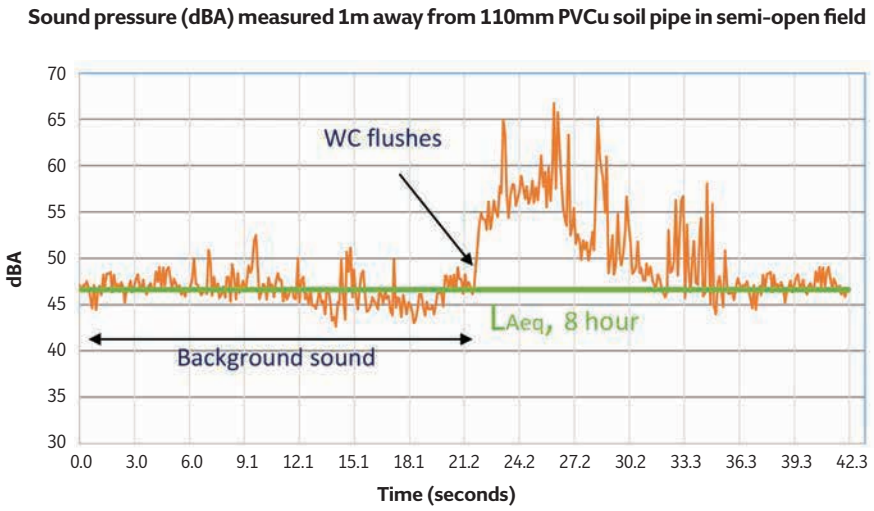

Figure 2: Sound pressure adjacent to example soil pipe when WC flushes. Using time-averaged sound pressure levels will not identify any potentially disturbing sounds from the soil stack

So, for example, in the middle of an office, if the sound pressure (at a particular frequency) is 1.2×10^{-3} Pa, the sound pressure level, Lp =

$$20 \log_{10} \frac{1.2 \times 10^{-3}}{2 \times 10^{-5}} = 36 \text{ dB}$$

A 3 dB change in sound pressure level is just noticeable, 5 dB clearly noticeable and 10 dB has a perceived volume as being twice (or half) as loud. In an open space, the sound pressure will halve as the distance from the sound source is doubled (since the noise is spreading across an area $4\pi \cdot \text{distance}^2$) – the reduction with distance is somewhat less in a room because of its reflecting surface.

The ear does not respond equally to all frequencies. This is reflected in the **phon** scale, as shown in Figure 1. For example, the 40 phon contour shows values of Lp for other frequencies that are perceived equally loud as 40 dB at 1,000 Hz, so at 100 Hz a sound pressure level of nearly 60 dB will have the same perceived loudness as 40 dB at 1,000 Hz. The curves indicate that generally low (or very high) frequency sounds need to have a greater sound pressure level to be perceived as loud as less extreme frequencies.

The value of sound pressure level may be frequency 'weighted' in terms of the perception of human hearing. There are several different types of weighting that may be applied, but for the relatively low sound intensities experienced within buildings, the weighting network A, dBA, is commonly used. This approximately simulates the 40 phon contour by weighting (biasing) the measurements of the sound pressure level measured across each of the octave bands (that is, with centre frequencies of 62.5 Hz, 125 Hz, 250 Hz, ...16 kHz), or across third-octave bands. Sound level meters will normally produce a direct display in dBA with no need for manual conversion or calculation. Where there is predominantly low frequency noise, dBA may well underestimate the apparent loudness. However, the A weighting is widely used to describe noise levels for building services applications.

There are several other common measures of sound criteria used in buildings, and particularly associated with building services noise. These include noise criterion (NC) and, where a better appreciation of sound 'quality' is demanded, room criterion (RC) – these are discussed more fully in CIBSE Guide A 2015 section 1.10.5. These are directly available as outputs on modern sound level meters.

Sound emissions from soil systems are likely to be intermittent, and with lightweight plastic systems the intensities and frequencies can be challenging to moderate, because the flow within the pipe generates noise through impact or turbulence as the flow is varying and disrupted. This may not be obvious when noise surveys are carried out, since the noise will be dependent on the actual use of the sanitary appliances. A simple noise survey will typically apply a time-averaged value of sound pressure to provide an equivalent continuous A-weighted sound pressure level over a particular time period T given[2] by

$$L_{Aeq,T} = 10 \log_{10} \left[\frac{1}{T} \int_0^T \frac{p_A^2(t)}{p_0^2} \, dt \right]$$

where $p_A(t)$ is the instantaneous A-weighted sound pressure level and p_0 is the reference sound pressure (20 μPa).

Depending on the length of period, T (typically several hours), this will effectively obfuscate any intermittent sounds, since this type of measurement is particularly suited to evaluating the time average sound levels. A continuous measurement – such as that shown in Figure 1 – can create a better tool to identify the intermittency of such sounds.

An office is likely[3] to have a $L_{Aeq,8hour}$ of between 35 dBA and 45 dBA, while a place suitable for relaxation – including domestic living spaces in peaceful areas – is likely to

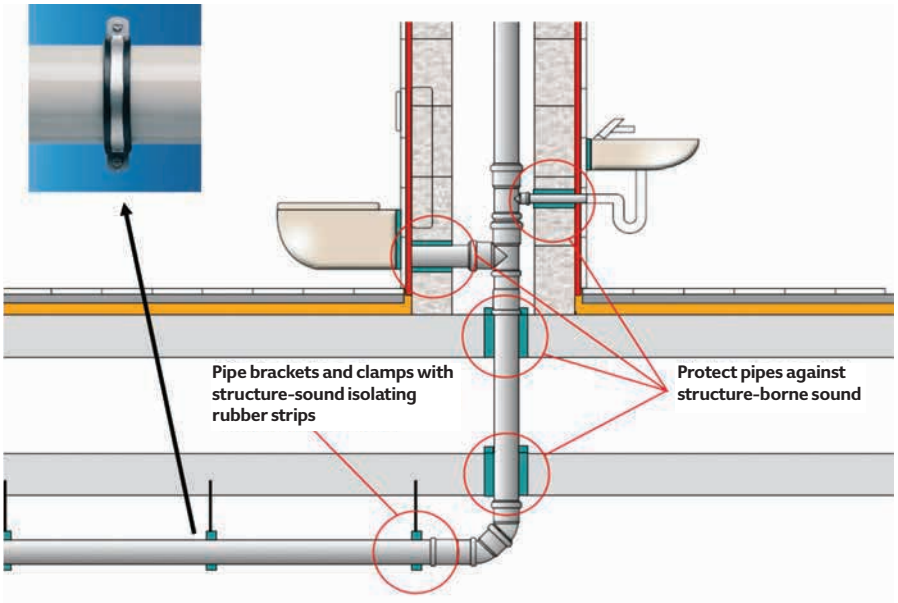

Figure 3: Soil and waste pipe arranged to reduce structure-borne sound (Source: Wavin)

be between 30 dBA and 35 dBA. Since dBA values are based on logarithmic relationships, two separate sound sound sources (for example, X dBA and Y dBA) cannot simply be added to indicate a total sound pressure level. Two identical value sound pressure levels (for example, 35 dBa + 35 dBA) will give a combined additional value of +3 dBA (that is, 38 dBA). If the difference between the two values is greater than 9 dB, then the overall sound pressure level practically will simply be the higher of the two values. Typically, the noise levels (at source) from water and sanitary appliances and fittings[4] lie in the range 45-85 dBA, and so can dominate the acoustic environment in an occupied room.

Noise from soil and waste pipes

The sound from soil and waste pipes can transfer into the occupied space: directly from the surface of the pipe as airborne sound; through the building structure where the pipe is not isolated from the adjacent surfaces (either through pipe supports or by direct interference); or along the pipe to and from a connected appliance. As noted in Wise and Swaffield's seminal book[4], the 25mm depth of water seal required for sanitary purposes (as provided by the waste trap) is also generally adequate to prevent the transfer of noise emanating from the connected appliances.

CIBSE Guide G notes that the building construction has a bearing on the measures required. For example, steel-framed buildings transmit sound far more easily than a concrete-framed buildings, and so the designer needs to be particularly diligent in specifying pipework supports with 'acoustic' inserts and sleeves to alleviate structure-borne sound. Structure-borne sound can be complex

Figure 4: Installation of 'acoustic soil' in a care home (Source: Wavin)

to address, so to reduce potential problems, bends should be minimised and any direct contact between the soil pipe and the structure must be avoided. To meet the design requirements, many manufacturers offer support systems that reduce the transmission of sound, such as that shown in Figure 3.

As discussed by Lewis and Swaffield, when considering noise transmission through building structures the so-called 'mass law' applies. A 230mm brick wall (400 kg · m^{-2}), for example, will provide attenuation of about 50 dB, a 115mm brick wall 45 dB, and a partition weighing 50 kg · m^{-2} about 35 dB. 'Indirect' or 'flanking' pathways create a means by which sound can bypass a dividing wall or floor through poor detailing, particularly where surfaces meet. The openings around pipes must be treated effectively to reduce noise transmission, as shown in Figure 3. Determining the actual level in the receiving room is complex, and will depend on factors[2] including: sound insulation and area of the separating wall or floor; the volume of the receiving room; the flanking transmission; and the amount of absorbing material (for example, furniture) in the receiving room.

As well as airborne noise from soil systems, problems resulting from structure-borne sound that cannot be successfully dealt with by the building's insulation can often be remedied using an appropriately robust 'acoustic' soil and waste system. So, for example, 'acoustic soil' – such as the system shown in Figure 4 – has a higher mass than traditional plastic soil pipe, and the structure of the plastic is designed to reduce the structure-borne sound. In conjunction with using appropriately resilient 'acoustic' fixings, this can enable an improved level of soundproofing, without requiring additional acoustic insulation wrapping or architectural ductwork that normal plastic pipework may require. The system illustrated here employs push-fit jointing sections, with a resilient gasket that isolates the pipe from the fitting, to stop noise passing along the pipe from one space to another.

Having installed the system to the appropriate standards, the normal on-site airborne and impact noise tests only measure the performance of the whole room – without testing the performance of the soil stack when in use. Any design or installation errors could easily be overlooked, and warrant a planned assessment of the acoustic performance when WCs are being flushed or baths emptied.

References:

1 England Building Regulations Approved Document E *Resistance to the passage of sound*, 2015 amendment.

2 BS8233:2014 *Guidance on sound insulation and noise reduction for buildings*, BSI Standards, 2014.

3 CIBSE Guide B5, *Noise and vibration control for HVAC*, CIBSE, 2002.

4 Wise, A. F. E. and Swaffield, J. A., *Water, Sanitary and Waste Services for Buildings*, Chapter 10, Butterworth-Heinemann, 2002.

Turn over page to complete module

Module 93

May 2016

wavin
CONNECT TO BETTER

1. Which part of the England Building Regulations is noted as referring to acoustic performance of soil and waste systems?

- ☐ A AD Part C
- ☐ B AD Part E
- ☐ C AD Part G
- ☐ D AD Part J
- ☐ E AD Part L

2. What is the approximate sound pressure level at 100 Hz for the 60 phon loudness curve?

- ☐ A 50 dB
- ☐ B 60 dB
- ☐ C 70 dB
- ☐ D 80 dB
- ☐ E 90 dB

3. If a sound pressure level of 42 dBA is added to one of 32 dBA, what is the resulting sound pressure level?

- ☐ A 32 dBA
- ☐ B 35 dBA
- ☐ C 42 dBA
- ☐ D 45 dBA
- ☐ E 74 dBA

4. What depth of water trap is noted as being sufficient to prevent noise from appliances?

- ☐ A 15mm
- ☐ B 25mm
- ☐ C 35mm
- ☐ D 45mm
- ☐ E 55mm

5. In the soil pipe system illustrated in Figures 3 and 4, which of the following is not specifically applied to make it particularly effective at reducing noise?

- ☐ A Resilient 'acoustic' fixings
- ☐ B Push-fit joints with resilient gaskets
- ☐ C Higher mass pipework
- ☐ D Protection from touching the structure
- ☐ E Acoustic wrapping

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Alpha installs its own ARES Tec at head office

When the heating system at Alpha Heating Innovation's head office, Nepicar House, was at the end of its life, the company recognised how its own ARES Tec commercial system would be the ideal replacement, installing an ARES Tec 200kW, complete with safety kit and plate heat exchanger.

Stephen Burton, managing director of installers Antac Support Services, said: 'We have worked with Alpha for years and have always been impressed by the products they offer.'

● **Visit www.alpha-innovation.co.uk**

ATAG Commercial's Q Series boilers for larger homes

Q Series boilers from ATAG Commercial have been specifically designed for larger homes and properties with high hot water demands. Incorporating top quality components – such as a stainless steel heat exchanger – the range offers high levels of energy efficiency.

The compact range of boilers is available in three combination models, with outputs of 25kW, 38kW and 51kW, along with four system versions offering outputs of 25kW, 38kW, 51kW and 60kW.

● **Visit www.atagcommercial.co.uk.**

Big Foot Systems supplies solution to Coca-Cola Enterprises GB

Big Foot Systems supplied a custom Safe Access solution and a rooftop plant support to Coca-Cola Enterprises Great Britain (GB) at its Wakefield manufacturing plant – the largest soft drinks manufacturing plant, by volume, in Europe – to increase ventilation capacity. The complex project saw Big Foot's technical team come up with a solution that used its HD Beam system to span the main rafters and the purlins, taking the load back to the main rafters. The solution also provided safe access for maintenance.

● **Call 01323 844355 or email enquiry@bigfootsupport.com**

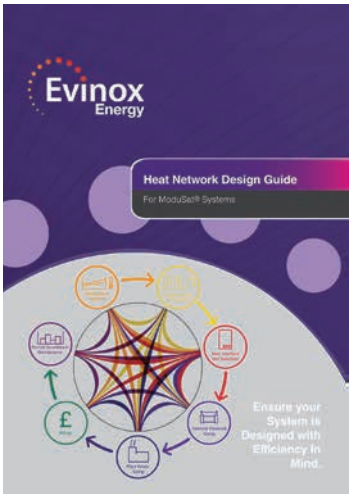
The new Aquatech Pressmain A Pod – Packaged Plantroom

Designed as a single-piece item with two sections – one for stored water, the other for a booster set – the unit can be delivered to site.

Once positioned, it requires the simple connection of mains pipework, outlet pipework to services and electrical supply, making it a 'plug and play' unit.

Tank sizes are available from 1,600-10,000-litre nominal storage capacity.

● **Call 01206 215 121, email marketing@aquatechpressmain.co.uk or visit www.aquatechpressmain.co.uk**



New Heat Network Design Guide champions efficiency

Evinox Energy has launched a *Heat Network Design Guide* and CPD seminar for communal and district heating systems. The guide contains all the key factors to consider when planning, designing and delivering a communal or district heating project.

The scope of any heat network project begins at the planning stage and carries through to system design, product selection, network maintenance and end user support. Attention to detail must be applied at every stage of the project in order to deliver a successful, efficient and cost effective heat network.

Successful design, installation and operation relies on factors that can vary from project to project. Evinox Energy's free guide supplements other industry standards, guidelines, regulations and codes of practice. The CIBSE-approved CPD seminar explores this topic in depth to identify new ways to add value, performance and efficiency to your heat network project.

● **Call 01372 7222 77 or visit www.evinoxenergy.co.uk**

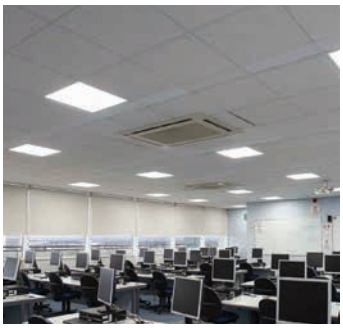
New low cost super condensing boilers from Atlantic

Atlantic Boilers has introduced a new product to the market – the BK Series of super condensing boilers burn diesel oil or natural gas.

There are three models in the range: 50kW, 70kW and 100kW with efficiencies exceeding 92% GCV throughout the year, including in mid-winter. The boilers benefit from multi-pass heat transfer, while a neutraliser removes sulphur residue from the oil. Flue outlet temperatures are always less than 48°C.

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

Hull College benefits from Luceco lighting



Chelt Electrical, in Hull, has installed more than 600 Edgelit LED LuxPanel luminaires from Luceco throughout Hull College, funded by the Salix scheme.

High efficiency, energy-saving LuxPanels from Luceco were quick and easy to install into exposed grid ceilings, delivering up to 50,000 hours' life with no maintenance requirements. The luminaires were installed in classrooms, circulation areas, corridors, lecture suites and relaxation areas, as well as specialist facilities, such as beauty salons.

● **Call Zoe Newland-Hodges on 07890 320 152 or email Zoe.nh@luceco.uk**

Rinnai's infinity HDC1600i/e gets 'A' rating

Rinnai's Infinity HDC1600i/e low NO_x, gas-fired continuous-flow water heater delivers commercial qualities of hot water – up to 37 litres per minute on demand – to any site and application.

Rinnai, manufacturer of a wide range of continuous flow gas-fired water heaters, has 'A' rated Eco-labels on all its units. Eco-labelling of products offers transparency to specifiers and gives end users a clear and simple guide when sourcing the most energy efficient hot water heating units.

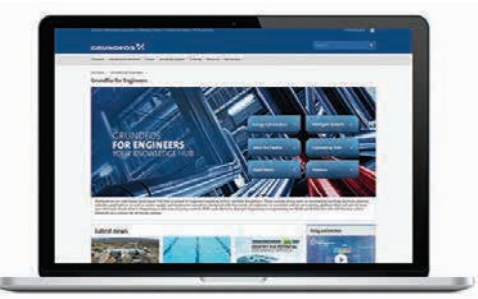
● **Visit www.rinnaiuk.com**

Grundfos hub: engineered for engineers

Grundfos launched its knowledge-based hub last year, specifically aimed at engineers who work across multi-disciplines.

Designed by engineers, for engineers, this hub was developed to be an evolving platform to keep all engineering partners who are interested in pump technological advances informed about the latest happenings in the industry, as well as on the wider subject of fully integrated pump systems.

It is broken down into easily accessible sections, with topics including applications; products and engineering tools; energy optimisation; and how to build on system intelligence. There is also an opportunity to watch a range of a clips such as 'Meet the experts', where engineers share their expertise on applications and their challenges.



To find out more, log on to www.grundfos.co.uk/engineers – with so many dynamic changes happening in engineering, this site should quickly become a firm favourite as a source for all things pumps.

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

Rehau launches new NEA smart underfloor heating controls

Underfloor heating specialist Rehau has launched a new family of underfloor heating controls that are perfectly integrated with its range of popular floor systems for a truly compatible solution for residential and light commercial projects.

The Rehau NEA Smart System has just three core components – the NEA Smart base station and a choice of two room thermostats, making it simple to operate and easy to install, while optimising both efficiency and comfort levels.

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

Exposed ceilings and plenum air conditioning – a perfect partnership

AET Flexible Space specialises in underfloor air conditioning technology and has worked with designers for 25 years to overcome structural and height restrictions, as well as design challenges associated with new build and refurbishment projects alike.

By adopting an air conditioning system that can both supply and return air via the floor plenum, designers are free to make use of ceiling space and features in a very different way.

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

ZoomLock: transforming the world of air conditioning

A range of braze-free refrigeration copper fittings from 0.25 in – 1.375 in are being brought to the UK by air conditioning and ventilation specialists, Greenmill.

Greenmill's ZoomLock system is transforming the world of air conditioning and refrigeration installations. Using patented technology to join copper tubes, ZoomLock fittings will safely sustain pressures of up to 700psi /48Bar.

No need for hot works, the joins reduce your risk and create a safe and productive environment to work in for you and those around you.

● **Visit www.greenmillac.com**

Geoff Byrne, business development manager, Precision Cables, and (right) Tony Vose, MMS account manager, Draka

Lunch and learning with Draka

Lunchtime continuing professional development (CPD) sessions, run by cables and systems specialist Draka, are proving to be a huge success with mechanical and electrical consulting engineers.

Draka currently provides three Lunch & Learn CPD sessions developed to educate and inform professional engineers in the UK and Ireland. Currently available topics are: 10Gb Copper Structured Cabling (shielded and unshielded); A Guide to Structured Cabling; and Remote Powering. Draka is part of the Prysmian Group.

● **Visit www.prysmiangroup.com**

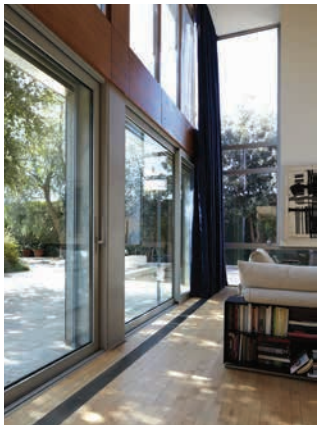
Mikrofill supplies condensing boilers to Bedfordshire NHS Trust

Bedford Hospital NHS Trust is a high-performing 403-bed district general hospital. Eta Energy Systems prepared a full technical design with specification for the replacement of its existing CHP plant.

The proposal incorporated three Mikrofill Ethos 130kW stainless steel condensing boilers. Operating in conjunction with a CHP unit, the boilers primarily serve the hospital's hot water supply demand, but are configured to provide heat into the main system when hot water requirements are at a minimum.

● **Call 03452 606020 or visit www.mikrofill.com**

Jaga offers shallow trench heating in five lengths



Super-shallow Micro Canal trench heating is now available in lengths of 600mm, 950mm, 1,300mm, 1,650mm and 2,000mm from Jaga Heating Products. At only 60mm deep, the Jaga Micro Canal is one of the shallowest trench heating products available. Compared to similarly sized trench heating systems, the Micro Canal ensures an optimum balance between practical dimensions and powerful output, opening up a new range of design possibilities for building services engineers and architects.

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

Wieland's Metalynx2 channels the power through Lacon London

Wieland Electric's structured wiring system, Metalynx2, and Gesis plug and play system has been used for the connection of power and lighting throughout the refurbished Lacon London, an eight-storey commercial building in the heart of Holborn, London. Imtech UK specified Wieland's Metalynx2 armoured cabling system. Using the pre-wired and pre-tested system resulted in a 70% reduction in installation time.

● **Call 01483 531 214 or visit www.wieland.co.uk**

School achieves £3,000 gas savings and increased heat output with Remeha boilers

Remeha boilers has helped cut gas consumption at Sandbach School in Cheshire by £3,000 in just four months, in a win-win solution that also increases the heat output to meet its present-day requirements. Jonathan Scott, director at TBR 24-7, recommended installing four Remeha Quinta Pro 115 replacement boilers in cascade in the plant room serving the main building, and two further Quinta Pro 115 boilers in the second plant room as a rapid, high-quality solution to meet the tight refurbishment schedule. New pumps, new controls and a full BMS control completed the project, enabling 24/7 monitoring of the site.

● **Call 0118 978 3434, email boilers@remeha.co.uk or visit www.remeha.co.uk**

Oventrop offers integrated solution

Oventrop Projects Division successfully designed, supplied, installed and commissioned a 7,300m^2 Oventrop Cofloor underfloor heating system at Cobalt Place, a 104-dwelling development in Battersea Village, made up of apartments and townhouses.

Oventrop was chosen by developer Lend Lease, along with contractor Cilantro Engineering UK, for its ability to provide the Regudis heat interface unit and the complete UFH installation.

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

Elta Fans get on track for Go Karting project in Liverpool

Team Sport, Europe's largest indoor karting operator, opened its newest race circuit in Liverpool in December 2015. East Lancashire Refrigeration, in Blackburn, was chosen as the contractor and used Elta Fans Multiflow SEM in-line fans sourced through SK Sales.

The project needed the correct extraction of CO_2 from the petrol engines of the karts, so the installation of an appropriate ventilation system was critical.

● **Call 01384 275 800, or visit www.egbuildingservices.co.uk**

Powerstar seminars

Powerstar will host free seminars on 26 May at the Best Western, Pinewood in Wilmslow, near Manchester, and on 2 June at the Powerstar head office in Sheffield. Attendees will get the opportunity to learn about Virtue, a new energy storage system that allows businesses to store electricity generated during periods of low demand for use when required. Virtue can also be integrated with renewable generation sources, allowing sites to become virtual power stations.

● **Email events@powerstar.com or visit www.powerstar.com/events**

PRODUCTS & SERVICES

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Viessmann launches the first boilers with WiFi and internet connectivity

Heating systems manufacturer Viessmann is introducing the first boilers with WiFi and internet connectivity, helping installers increase customer loyalty by responding promptly to automatic fault notifications, as well as enabling remote performance monitoring and online service-planning.

All new Viessmann Vitodens 100-W/111-W and 200-W/222-F/242-F gas condensing boilers, which go on sale in September, can be WiFi enabled. All 100 and 200 range models installed since 2007 can be WiFi enabled with a £60 control accessory.

● **Visit www.viessmann.co.uk**

JS Air Curtains announces new area sales manager

Chris Prentice has joined JS Air Curtains as the area sales manager for the Midlands and north of England.

Prentice, who is based in Sutton Coldfield, Birmingham, has more than 20 years' business experience in the HVAC industry, having previously worked at ICS Cool Energy and Fläkt Woods.

In his new role at JS Air Curtains, he will be responsible for supporting and strengthening air curtain sales throughout his region.

● **Visit www.jsaircurtains.com**

Competitive quotations from Aircon Installations

Aircon Installations has specialised in major air conditioning plant replacement since 1992.

It offers all insurances, including £5m professional indemnity, and competitive quotations for the installation of water chillers, air cooled and water cooled, any make, plus air handling units, cooling towers, condensing units, pumps, power cables, steel structures and acoustic enclosures.

Aircon Installations would be pleased to submit its best price to your specification.

● **Call 0845 006 1403, email info@aicrs.co.uk or visit www.aicrs.co.uk**

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Meeting Renewables Targets

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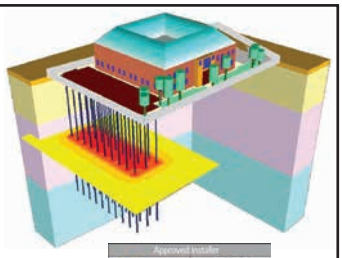

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Green Ventilation

Mechanical Design Engineer • Ipswich

Space Engineering Services delivers nationwide refrigeration, mechanical and electrical services to a range of business customers. From design and manufacture to installation and service and maintenance, we are committed to excellence in understanding, delivering, and managing our customers' needs.

Orwell Design Associates is a specialist consultancy providing world class system design and is part of Space Engineering Services Ltd.

As part of our continuing growth, we are looking for an experienced Mechanical Design Engineer, to work out of our Ipswich Design office. Ideally the candidate should be degree qualified, have extensive knowledge of the design and build process on food retail, non food retail, commercial, industrial and refurbishment type projects.

The successful candidate will report into the Design Director.

Candidates will be required to have:

- A working knowledge of CIBSE (Chartered Institute of Building Services Engineers) technical documents, and UK Building regulations.
- Experience in the design selection and sizing of mechanical public health aspects of building services with sound calculation and experience on Hevacomp and Cymap.
- Experience of working on retail, industrial and commercial projects.
- Complete regular work load programmes.
- The ability to chair full design meetings, and create fully legible minutes of those meetings.
- Undertake site surveys.
- Competence in providing/producing detailed design documentation for others to work to.

Key skills and experience required:

- Recognised industry qualifications.
- Proven track record.
- Able to communicate at all levels, internally and with customers.
- IT proficient - all key Office products, including Excel to at least intermediate level.

This right person would be required to oversee the mechanical requirements of the business from the initial survey, through the design and specification stages, to the installation and management, on retail and industrial projects to support any and all of these projects to be timely delivered.

The Mechanical Design Engineer will take technical lead on specific projects, for both Space Engineering & Orwell Design Associates, as identified by the Design Director.

If you are self-motivated, forward-thinking and a strong team player, enthusiastic about, and committed to, delivering the best for the customer, we want to hear from you.

In return, we offer a competitive salary and benefits package, along with opportunities for development and promotion.

Applications should be emailed to applications@space-engineering.co.uk.
Please include a copy of your CV, and details of your current salary.

LEED-ING THE WAY

After her inspiring speech at CIBSE's annual lecture, *CIBSE Journal* caught up with Arup principal **Fiona Cousins**. Here, she shares her journey, and her experiences of working in the United States

After graduating from the University of Cambridge with degrees in engineering science and interdisciplinary design for the built environment, Fiona Cousins joined Arup's London office. She now works in the firm's New York office where she is part of the the sustainability and mechanical engineering teams. She is an Arup Fellow and directs research investments for Arup's Americas region. She is also a member of Arup's Americas Board.

As a professional engineer, with a background in mechanical engineering design, Cousins has spent much of her career engaged in HVAC design, specialising in thermal comfort and energy efficiency.

She frequently presents on transformative sustainable building design, and has given technical papers in the areas of low-energy design and sustainability.

She co-authored *Two Degrees: Climate Change* and our built environment and is currently chair of the USGBC.

How did you end up in New York with Arup?

I started out at Arup, in London, in the early 90s, working in the research and development team on computer programmes for thermal analysis of highly-glazed spaces and atriums. A year later, I moved to a design group, where I worked on a number of projects, including the 20-storey 84m-high Stadttor in Düsseldorf, Germany, for which I carried out the thermal modelling of the double skin façade; the Lingotto factory in Turin, Italy; and as a project site engineer for a dispensary in Tanzania. I also worked on the Lisbon Oceanographic center before transferring to Arup's San Francisco office and then on to the New York office.

> Engineers provide the knowledge that the rest of the design team needs to tap into to play their part in the design

How can building services engineers ensure low-energy buildings are actually built?

One of the things I have found is that to do a low-energy design, you have to get the architects, owners, engineers and operators aligned. This involves a lot of people, and engineers are key to the process because they understand how energy flows. They provide the knowledge that the rest of the design team needs to tap into to play their part in the design. Engineers need to do be able to mobilise everyone, and communicate clearly so that their information becomes useful.

How does mandatory labelling work in New York?

Display Energy Certificates and Energy Performance Certificates do not exist in the US. In New York, buildings that are more than 50,000ft^2 have to report their annual energy and water use, and these figures are published. Building owners can then compare their consumption to their neighbours', and to previous years. Energy policy in the US for buildings and cars is a state – not a federal – responsibility, so there are only a few places where energy reporting is law.

How does Leed ensure good in-use performance?

One of the things we discovered in the US – especially in Chicago, New York and San Francisco – is that Leed became a mark of quality for newly constructed buildings. It became a shorthand in the market for a good-quality product and this made attention to water and energy use much more widespread.

Although Leed certification is usually granted on the basis of energy modelling during design, owners are required to submit data on the building's energy and water use for several years after they get their certificate. USGBC is also working on dynamic feedback for buildings in operation.

Energy regulations are a state matter in the US and the latest update of the ASHRAE standard 90.1 sometimes takes a long time to be adopted by individual states. Leed accelerates adoption by the market by using the up-to-date version as the baseline standard.

How aware of climate change is the US?

Most people in the US are aware of climate change but it's not universally accepted as a fact. Although willingness to accept climate change largely falls along political lines, both George W Bush and Barack Obama set policies to mitigate it.

What is USGBC's focus now?

USGBC is focusing on making green buildings healthy and affordable. One in six Americans go to school every day, so we also have a focus on making schools better buildings and better learning environments. We have extended the number of rating systems that we support through GBCI to include Well, Peer, Sites and Edge, all of which have different areas of focus in the built environment. We are also working to record performance in use through the new ARC system.

● **FIONA COUSINS**, FCIBSE, is principal at Arup, and chair of the USGBC

Events & training

NATIONAL EVENTS AND CONFERENCES

CIBSE AGM and presidential address
5 May, London
The CIBSE AGM followed by address from incoming president, John Field, held at the Royal Society.
www.cibse.org/agm

Lighting Design Awards
5 May, London
Supported by the Society of Light and Lighting, the Lighting Design Awards are celebrating 40 years this year.
awards.lighting.co.uk

CPD TRAINING

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

Introduction to ground and water source heat pump schemes
10 May, London

Implementing ground and water sources heat pump schemes
11 May, London

Low carbon buildings for local authorities
11 May, London

Lighting and energy efficiency
12 May, Manchester

Design of ductwork systems
12 May, London

Building services explained
18-20 May, Exeter

Fire sprinkler systems: Design
20 May, London

Lighting design: Principles and application
20 May, London

High voltage (11kV) distribution and protection
2 June, London

Energy surveys
3 June, London

Variable flow water system design
9 June, London

Gas safety regulations (designing for compliance)
10 June, London

Building services overview
9 June, Manchester

Understanding and application of psychrometric charts
17 June, London

Energy efficiency building regulations
21 June, Manchester

ENERGY ASSESSOR TRAINING

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

LCC building operations and DEC
10-12 May, Leeds

Air con inspection
17 May, Leeds

Heat networks
18-19 May, London

LCC design and EPC
18-19 May, Newcastle

ISO 50001
24-26 May, London

LCC Design & EPC
7-8 June, London

Heat Networks
8-9 June, Leeds

Air con inspection
13 June, London

LCC building operations and DEC
13-15 June, London

ISO 50001
14-16 June, Birmingham

Heat networks
22-23 June, Edinburgh

LCC design and EPC
22-23 June, Manchester

LCC building operations and DEC
28-30 June, Manchester

CIBSE GROUPS, REGIONS AND SOCIETIES

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

West Midlands: Project presentation – Eon
4 May, Birmingham

YEN Ireland: Five-a-side soccer blitz
6 May, Dublin
Sponsored by Hitachi, the event will take place at AstroPark, Tallaght, on Greenhills Road.

Merseyside and North Wales: Committee meeting
9 May, Liverpool

HCNW: CIBSE membership evening
9 May, London

SoPHE: Domestic cold water – water treatment forum
10 May, London

West Midlands: Cyber security for intelligent BMS systems
11 May, Birmingham
Presentation looking at potential threats and impact of cybercrime on intelligent building management systems, and the importance of cyber security in the built environment.

Scotland: Integration of pipework systems
12 May, Glasgow
Presentation by David Palmer, of Campbell Palmer Partnership.

SoPHE: Assessing the lifetime of a continuously operated re-circulating system
12 May, Cambridge
Presentation by Wavin on legionella prevention and continuously operated recirculating systems.

Yorkshire: Water regulations – risk and responsibility
12 May, Leeds
Event hosted by Mark Johnson and Buro Happold Leeds, with a presentation from Yorkshire Water.

ILEVE AGM and technical event
17 May, Derby

SoPHE: Cold water storage control and delayed action valves
18 May, Manchester
Presentation by David Meacock, technical director at Cistermiser/Kerfalo, and Paul Taylor, Cistermiser.

Society of Light and Lighting masterclass
26 May, London
Continuing the masterclass series – Inside Out: Light and Architecture.

HCNW: Building physics and optimised design – design by algorithm
26 May, London
With speakers Cathie Simpson, of Building Simulation, and David Cocking, of DesignBuilder.

New training courses for ground and water source heat pump schemes

CIBSE has developed two new training courses to support the new Surface Water Source Heat Pumps Code of Practice, published in March. The two courses, 'Introduction to ground and water source heat pump schemes' and 'Implementing ground and water source heat pump schemes', were developed as a joint initiative with the Ground Source Heat Pump Association.

Heat pumps are a low carbon technology that will play an important role in the UK's future energy strategy, so the first course will inform participants on the best methods for employing this technology. For building owners/operators/users, heat pumps can offer an efficient and, therefore, economic source of renewable heating and/or cooling, as well as benefits in terms of government incentives, planning approval and reputation.

The introductory course gives an overview of ground and water source heat pump schemes, aimed at building owners or those involved in developing energy strategies. It outlines the key benefits and challenges of this technology and different ways it can be applied.

The second day course, will build on the material covered in the Introductory course, covering in greater detail the stages, goals, minimum requirements and responsibilities as defined in CP2, featuring worked examples and case studies.

The courses are designed to be stand-alone, but complementary, so it is possible to do one or both days depending on your levels of knowledge and prior interest.

The courses are underpinned by the recently published *Surface water source heat pumps: Code of Practice for the UK*, a copy of which will be given to each attendee.

Introduction to ground and water source heat pump schemes 10 May, London
Implementing ground and water sources heat pump schemes 11 May, London

For more information and to book visit **www.cibse.org/training**

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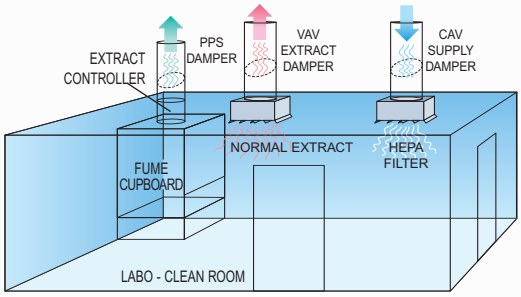

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CIBSE BUILDING PERFORMANCE CONFERENCE AND EXHIBITION

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www.cibse.org/conference

The CIBSE Conference and Exhibition will inform and inspire building services professionals including consultants, designers, facilities managers and engineers, and offer up to 10 hours of CIBSE CPD.

What To Expect

Inspiration - Achieving performance in use: what good performance really looks like.

Tools and Techniques - How best to derive value from digital engineering.

Opinion - The direction of travel regarding policy: what's on the horizon and its impact on building services engineers.

Lessons Shared - The challenges of refurbishment & retrofit: case studies across different building types.

Performance. Inspiration. Aspiration.

17-18 November

2016

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Westminster, London

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For more information please contact Michelle Michelucci today on 01892 518877 or email conference@cibse.org

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