CIBSE JOURNAL

The official magazine of the Chartered Institution of Building Services Engineers

February 2016

WITH THIS ISSUE *Careers Special*

PASSIVHAUS GOES MAINSTREAM

Camden Council adopts green standard for major renewal of Agar Grove estate

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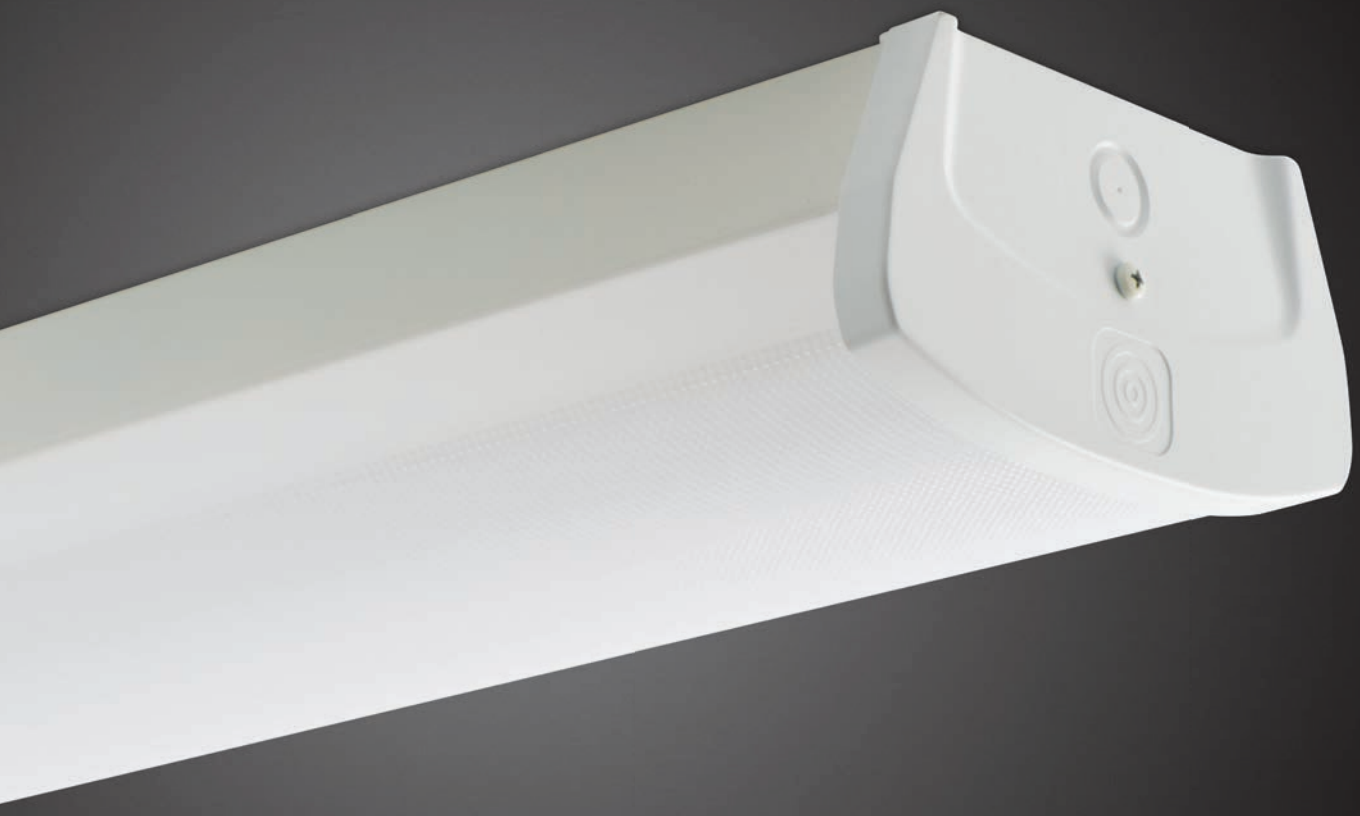

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Against the grain

The Passivhaus building standard celebrates its 25th birthday this year, and in Germany, its country of origin, it has become an established building method. In the UK, penetration has been relatively low with only 500 Passivhaus units built in the six years since the first was completed here.

This could be about to change, as a growing number of developers and public sector clients are adopting the standard on larger sites. One of the most exciting and challenging developments is in the London Borough of Camden. The local council is building 345 units to Passivhaus standards at Agar Grove, and the estate will feature an 18-storey Passivhaus tower – the highest in Britain.

The council says Passivhaus addresses its twin concerns of fuel poverty and carbon emissions. It is attracted to its simplicity and ease of maintenance; as Camden Council owns and manages the estate, this is a prime driver.

In our feature on page 22, Max Fordham engineer Bertie Dixon describes the challenges of designing to the standard on a complicated inner-city site. He explains how positioning buildings on existing streetscapes meant they were not placed in the optimal north-south orientation to benefit from solar gains. This meant designers had to tweak other criteria such as U-values, wall-window ratios, and duct lengths before they could meet the annual heat demand allowed by Passivhaus.

> Camden Council says Passivhaus addresses its twin concerns of fuel poverty and carbon emissions

Another obstacle to the standard is how it can conflict with UK regulations and planning conditions. The requirement for district heating in London planning law is problematic, as Passivhaus limits primary energy demand. This meant the designer had to find ways of minimising pipe runs in the heating network.

There were two fascinating debates last month – one hosted by *CIBSE Journal* looking at the future of heating, cooling and ventilating (page 48), and one at the Rumford Club (page 20), which looked at what engineers could do to avoid a worst case climate change scenario. Listening to both discussions, it was clear the industry has the expertise to reduce reliance on fossil fuels and improve the comfort of our buildings, but it was less clear how engineers could influence clients and others to do the right thing. Aecom's Ant Wilson had part of the answer when he urged engineers 'to spend more time learning how to motivate, how to mentor, and how to pass on skills'.

Alex Smith, editor
asmith@cibsejournal.com

NEWS

All the latest news from around the building industry

In brief

LONDON IN TOP THREE MOST EXPENSIVE PLACES TO BUILD

Construction costs in New York, London and Hong Kong can be as much as 60% higher than other major cities, according to a report from consultant Arcadis.

After analysing the relative cost of construction across 44 major cities in its International Construction Costs report, Arcadis concluded that strong currencies and significant resource constraints were leading to high prices in the US and UK.

INDUSTRY TALENT HONOURED

A diverse group of industry professionals has been recognised in the 2016 New Year's Honours List .

David MacKay, professor of engineering at Cambridge University and former DECC's chief scientific adviser, was knighted for services to scientific advice in government and science outreach.

Dr Nina Maria Skorupska, chief executive of the Renewable Energy Association and non-executive director of the WISE campaign to encourage women in STEM, was made a CBE for services to renewables and equality in the energy industry. While University of Huddersfield's director of estates and facilities, Colin Blair, MCIBSE, was made an MBE for services to higher education.

Jaz Rabadia, senior manager of energy and initiatives at Starbucks, was also made an MBE for services to sustainability in the energy management sector and STEM diversity.

CHINESE HELP TO GET ZERO CARBON HOMES IN BRITAIN

Up to 8,000 zero carbon homes are set to be built in the UK following the signing of a £1.1bn deal between UK solar developers WElink Energy, British Solar Renewables (BSR) and the China National Building Materials Group (CNBM).

In the first phase, 4,000 'pre-engineered homes' are set to be constructed in 2016-2018, featuring rooftop solar panels, energy storage systems and waste-to-energy technologies.

Atkins predicts huge building shortfall for London

S.BORISOV / SHUTTERSTOCK

Forecasts predict the population of the city will reach 12 million by 2050

The consultancy Atkins says that London is 'significantly underestimating' the level of development required to keep up with the city's growth over the coming decades.

In a report, it claims the capital's infrastructure plans are inadequate and there will be a 1.5 million shortfall in housing in the South East by 2050, leading to social problems of inequality, overcrowding, unbalanced economic growth, transport meltdown and 'degradation of the natural environment'.

Future Proofing London, which was produced in partnership with Oxford Economics and Centre for London, forecasts that the population of the city will reach 12 million by 2050; above the 11.3 million projected in the Greater London Authority's (GLA) London Infrastructure Plan.

'The GLA expects there to be 6.3 million workers in the capital at this time, but this figure will actually be reached 24 years earlier, in 2026,' according to the report. If new homes are delivered at the current rate – 26,000 annually over the past five years – the South East will be left with a major shortfall, it adds.

'London's position as one of the world's leading cities is in real danger of slipping,' said Mike McNicholas, Atkins' director for London. 'The housing supply and the projected population growth are a long way apart and this will only get worse if we carry on down the same path. There will be serious knock-on effects as the pressure of the growing population pushes onto underprepared infrastructure.'

The Atkins team urged a greater focus on infrastructure investment avoiding 'focus on cost benefit analysis, which overlooks environmental and social benefits'. It also called for planners to make use of 'big data to make better informed infrastructure and planning decisions'. The company added local authorities, businesses and developers should 'work more closely together to ensure they are taking these factors into account'.

Award-winning floating village lives up to its name

A pioneering nature reserve has risen above the floodwaters that drenched the North West, proving an example to architects and engineers.

The floating visitor village, which won new build project of the year at the 2012 CIBSE Building Performance Awards, is sited on the Meadow Lake at Brockholes, and has been designed to rise and fall with the water level.

Designed by Adam Khan Architects, with Price and Myers and Max Fordham engineers, Brockholes was built to reach a height of more than four metres

above normal water levels. On Boxing Day it reached 1.5 metres.

This meant a disconnection of the bridges leading to the village but they connected again when water levels returned to normal.

Reserve project manager from 2007 until it opened in 2011, Ian Selby, said: 'This was the first major flood event at Brockholes and the visitor village floated perfectly, the bridges worked and the mechanical and electrical systems continued to perform.'

The floating platform – a two-metre deep concrete box, 60 metres long by 40 metres wide and weighing 4,800 tonnes – was constructed by Balfour Beatty.

Selby said the village was an example of a building with long-term viability. To allow movement, the design uses underwater umbilical service connections – flexible pipes and cables – to provide essential services.

Engineer wages up by 5% on back of skills shortage

- **Intermediate M&E design engineers saw the highest growth of 7.5%**

The construction industry saw pay rising at double the national average last year fueled, largely, by skills shortages.

An exclusive survey carried out by Hays for *CIBSE Journal* revealed the average pay increase across all building services roles during the 12 months to September 2015 was 5%.

This is much higher than the growth of 2.3% seen over the same period in the UK average salary across all professions. Building services also beat the average pay rise seen in the wider construction and property sector of 3.6%.

Intermediate design engineers (mechanical and electrical) saw the highest growth within consulting roles, with a national average salary increase of 7.57%. On the contracting side, senior contract managers enjoyed the highest average increases of 8.34%.

Richard Gelder, UK director, property and built environment at Hays, attributes the situation – in part – to a chronic lack of skills. 'Even during the recession there was a shortage of skills in building services. The market has never really had an excess. Yes, people were laid off in the recession, but I believe more people retired and fewer entered the industry.'


Jerry Lehane

In addition, the recent salary rises have 'corrected' pay levels to counter the wage freezes and salary cuts seen during the seven-year downturn. Jerry Lehane, ChapmanBDSP's managing director, said: 'We had a few years without pay rises, so we increased salaries partly to adjust to that.'

Another survey – of the whole construction industry – by the Royal Institution of Chartered Surveyors (RICS) showed an average of 6% increases (compared with 2% across the rest of the economy). It warned that shortages would hamper the ability to deliver projects this year and apprenticeships alone would not be enough to plug the skills gap.

See page 61 for our exclusive salary survey results.

Energy efficiency is driving growth

Demand for energy efficient systems and a rise in consumer confidence is driving global growth in building services equipment sales, according to Frost & Sullivan.

The researcher estimated the worldwide market for HVAC technologies would reach $108.93bn in 2020, up from $80.67bn in 2014. 'Homeowners and end users from the construction and commercial industries are increasingly seeking out technologically innovative solutions as replacement products,' the research authors said. 'Consequently, HVAC equipment suppliers are diversifying their portfolios with new energy efficient and automated equipment lines.'

The report added manufacturers were gaining new customers, and 'getting existing customers to buy again', by adopting 'smart technologies' and by improving and promoting the energy efficiency improvements offered.

LOVE YOUR CURVES

The UK's first carbon neutral eco 'arc' will be unveiled at the University of Oxford's Harcourt Arboretum, in Nuneham Courtenay, in March.

The unique welcome centre has been developed by green building designer-manufacturer Green Unit – started by Oxford graduate Philip Clayden – and constructed by Beard.

Visitors will be able to experience 360-degree views of the extensive collection of trees from around the world.

The arc is made from sustainable materials with cutting-edge insulation design, triple glazing and a green roof, while its high-performance mechanical ventilation with heat recovery system (MVHR) reuses up to 95% of the heat that would otherwise be lost.

WSP and HOK win research hub contract

WSP Parsons Brinckerhoff and HOK Architects have secured a major contract with the University of Glasgow to develop a £40m research hub.

The facility, to be developed on the 31-hectare Gilmorehill Campus, will be the second part of what the university has described as an 'inspirational and world-leading masterplan' for the West End campus.

The multidiscipline engineering contract is being led by WSP Parsons Brinckerhoff's John Cox, building structures lead in Scotland, and Graeme Bruce, who heads up the building services business in Scotland.

Arup heats up Manchester corridor

Arup has been appointed to a number of heat networks commissions in the North of England.

The consultant will undertake heat mapping and masterplanning to identify opportunities for heat networks in both Greater Manchester (GM) and the Leeds City regions.

As part of the GM heat network programme, Arup will help the region begin to deliver its ambitious carbon reduction target of 48% by 2020. This will include developing decentralised energy schemes and progressing options to business case level in Manchester, Salford, Bury and Tameside.

Among these projects is 'Corridor Manchester', which has identified an opportunity to establish a significant heat network that is now going to advanced business case stage.

These appointments follow on from Arup's work on the Decentralised Energy Project delivery unit, which resulted in investments close to £100m.

Green light for British Land's City fringe scheme

Developer British Land will undertake the £300m Blossom Street redevelopment in London, after mayor Boris Johnson backed the scheme.

Work on the 347,000ft² regeneration scheme near Spitalfields Market will start straight away.

British Land's plans were opposed by local conservationists keen to protect the character of the historic Norton Folgate neighbourhood on the City fringe. But Johnson over-ruled Tower Hamlets Council, which had previously rejected the scheme.

The developer plans to refurbish several existing derelict warehouse buildings and construct new blocks on vacant sites to create mainly office space, along with 13 shops and 40 flats.

BPA welcomes Peter Caplehorn to central London awards night

- **Gongs will be presented to each of the 13 category winners**

Policy director and deputy chief executive of the Construction Products Association (CPA), Peter Caplehorn, will address the 2016 CIBSE Building Performance Awards at London's Grosvenor House Hotel on 24 February.

The awards night, hosted by BBC presenter Louise Minchin, will be attended by 700 industry guests with a passion for engineering excellence and eliminating energy waste in building stock.

This year's shortlisted entries are responsible for projects, products and initiatives that exceed user expectations of comfort and performance.

Guest speaker Peter Caplehorn

In his role at the CPA, Caplehorn works to ensure that the UK and EU policy and regulatory framework – particularly for technical and sustainability issues – supports a growing and profitable construction products industry.

A chartered architect, with more than 30 years' experience in construction, he is deputy chair of the Building Regulations Advisory Committee, and currently chairs the British Standards Institution's strategic committee for construction.

Before joining the CPA, Caplehorn was technical director at Scott Brownrigg. He also chaired major industry events and was central to the delivery of several British Standards and Publicly Available Specifications, including PAS 91 and BS 8560.

The author of *Whole Life Costing: A New Approach* – and of articles in *RIBA Journal*, *Building Design* and *Building* – he has given evidence to all-party parliamentary enquiries, and appeared on radio and TV, as well as at Grand Designs Live.

Find out who takes home the awards and book your table at **www.cibse.org/bpa**

Bank lights up new energy finance model

Santander has embarked on a project to retrofit LED lighting across its UK estate of 800 branches and 13 office buildings, under the terms of a new 'financing model' that spreads the cost over 10 years in partnership with provider GE.

To achieve energy savings of more than 50% and reduce greenhouse gas emissions by more than 7,000 tonnes annually, 90,000 new lights will be fitted.

The lighting is procured and managed without any capital outlay by the bank, with GE providing system design, installation, maintenance and management over the course of the contract. Described as a 'cash-positive financing model', the businesses said this could 'reinvent the way companies think about investment in energy efficient lighting upgrades'.

The Green Investment Bank and Sustainable Development Capital are providing the £17.5m finance, in what is claimed to be the biggest LED-financing package in the UK.

In a joint statement, the project partners said this 'unconventional approach, in which the financing partners enable the lighting to be procured as a service, rather than a product purchase' could pave the way for other organisations to invest in energy efficiency services without an impact on their balance sheet.

JULIUSKIELAITIS / SHUTTERSTOCK

FLIGHT OF THE VIEWING POD

CREDIT: KEVIN MEREDITH/BRITISH AIRWAYS I360

CREDIT: BRITISH AIRWAYS I360

The British Airways i360 glass viewing pod – conceived and designed by London Eye creators Marks Barfield Architects – has been completed on Brighton beach.

At 162 metres high, and with a 90-tonne observation pod rising to 138 metres, it will be the world's tallest moving observation tower – and the first vertical cable car – when it opens this summer. The heated and air conditioned pod will house a Sky Bar, and cater for 200 visitors at a time.

Engineers, POMA, built the pod in France, before dismantling it and delivering the segments to the Brighton site. The team plans to run a test flight in spring.

NAO doubts viability of major government projects

- **Audit office worried about 37 out of 106 projects**

A stark warning has been issued by the National Audit Office (NAO) about the viability of 34% of major government projects, including infrastructure and construction work.

In a new report, the independent spending watchdog said the public sector had a ' poor track record in delivering projects successfully', and cast doubt on the government's ability to deliver a sizeable number of the 149 schemes in its Major Project Portfolio.

These projects have a combined whole-life value of £511bn and were expected to consume £25bn of public money by the end of this year.

The NAO is particularly worried about 37 of 106 projects that are due to be completed in the next five years, giving them red or amber-red ratings in its early warning system.

It called for a better balance of 'ambition and realism in setting goals', along with a more 'effective mechanism for prioritising projects' or judging whether individual departments have the capacity and capability to deliver them.

PAUL DANIELS/ SHUTTERSTOCK

Major project: Crossrail

Paul McLaughlin, chief executive of the Building Engineering Services Association, said this was a major concern because of the importance of infrastructure work to the economy, and its impact on the construction industry.

McLaughlin pointed out that many building engineering firms had survived the last recession and emerged on the other side 'leaner and primed to meet tough new quality standards'. As a result, these firms 'have just the kind of expertise the government needs to overcome some of the problems highlighted by the NAO report'.

Renewable products face 15% VAT rise

The government consultation into revised VAT rates for energy saving measures is likely to lead to a 15% increase for a number of renewable products.

New rates of VAT must be applied to certain products from 1 August after the European Court of Justice ruled last year that the UK's special 5% rate for certain energy efficiency measures was illegal, and in breach of Europe's VAT Directive.

Biomass boilers and insulation may be allowed to remain at 5% because they are deemed to 'renovate' a building, but solar panels and wind turbines do not meet that definition, as set by the directive. The measures must also be used in social housing – or as part of a 'social policy', such as a strategy to reduce fuel poverty – to qualify for the lower rate.

CIBSE technical director, Hywel Davies, said: 'It is most unfortunate that the current VAT rate for these installations has to change because of a ruling in the European Court – not a change in government policy – with the renewables sector suffering as a result, on top of the other cuts in incentives it faces.'

BSRIA launches smart guide

BSRIA has released its third topic guide, covering 'smart technology' for anyone interested in smart products, the Internet of Things (IoT) and other developments. There is also guidance on the standard open protocols for intelligent buildings.

The guide was written by BSRIA's senior manager for energy and smart technologies, Jeremy Towler, who said the IoT was forecast to grow 'at a phenomenal pace'.

He added that it held the promise of 'a plethora of new applications and benefits', so the guide was designed 'to help the reader navigate this rapidly evolving area'.

TG09/2016 At a Glance – Smart Technology is free to download from **www.bsria.co.uk**

SBEM software overhauled by BRE

The BRE has updated its SBEM software with features aimed at meeting the requirements of the Climate Change (Scotland) Act.

iSBEM_v5.2.g can be used to assess compliance with the act, and for generating Scottish Energy Performance Certificates (EPCs) and Scotland Green Deal Advice Reports. It can also be used to ensure compliance with: Part L 2013 in England; EPC England; Part L 2014 in Wales; EPC Wales; Green Deal assessments for buildings in England or Wales; and Jersey 2007 Building Bye-laws Part 11.

Software glitch shuts down thermostats

Nest thermostats suffered a sudden loss of power after a software update late last year, said digital technology watchers.

Several users reported their thermostats shutting down heating systems unexpectedly because of a 'bug' that drained the thermostat's battery. Many US-based customers feared frozen pipes and other problems during extremely cold weather in parts of the country.

Google confirmed the cause was a 'software glitch' that didn't become apparent until the new year, following a large number of complaints on Twitter and on Nest's own forum.

Nest said the issue has been fixed for '99.5%' of affected users.

Ikea's talk of 'peak stuff' in line with efficiency aims

The world's largest furniture retailer believes western consumers can't consume any more.

In a statement that will chime with engineers focused on delivering resource efficiency in line with CIBSE's TM56 guidance, the Swedish company's head of sustainability, Steve Howard, said people's appetite for home furnishings had reached its peak.

But he said changes in consumption were an opportunity for companies to rethink the way they did business. Ikea is trying to help customers live in a more environmentally friendly way, he added.

'We will be building a circular Ikea where you can repair and recycle products,' said Howard, who is masterminding the firm's £755m renewable energy programme, and the phasing out of energy wasteful lighting.

The ASHRAE Winter Meeting was held in Orlando, Florida

SONGQUAN DENG / SHUTTERSTOCK

UK leads BIM discussion at ASHRAE conference

CIBSE members focused on importance of collaborative efforts within and between firms

The use of building information modelling (BIM), and its effect on project teams, was the subject of a high-profile seminar at last month's ASHRAE Winter Meeting, in Orlando, Florida.

Hosted by CIBSE ASHRAE Group chair, Tim Dwyer, 'Delivering Building Performance through Collaboration and Integration' looked at the impact of the British government's decision to mandate Level 2 BIM on all public sector projects by later this year. The fact that recent surveys show fewer than 15% of firms are properly prepared for this major change to design processes was also discussed.

'There is a very strong push for BIM in the UK,' Dwyer told the US audience during the CIBSE co-sponsored session. 'While the majority of firms have indicated they are not ready for the mandate (84%), nearly two-thirds have indicated it will be good for the industry and is the future for building services.'

BIM was a key theme for the conference, with nine other sessions – including seminars on tall buildings, air distribution techniques and heat pumps – featuring heavily.

The discussion, led by CIBSE members, focused on the importance of 'collaborative efforts within firms and between firms'. Dwyer added that an ever-increasing demand for 'more stringent building environmental requirements and collaboration across the building team' were critical to delivering 'effective buildings that meet standards and performance metrics'.

'Successful projects do not come from "silo" working practices. Increasingly, the engineer will be the lead for interdisciplinary design solutions that benefit from the integrating tools – which include BIM – and technologies, as well as timely and properly informed client communication and interaction,' added Dwyer, who is also technical editor of *CIBSE Journal*.

Rudd promises to support energy innovation despite government cuts

Energy Secretary Amber Rudd said she would 'light the fire of energy innovation' in Britain this year by investing in research and development. She told a London conference, organised by the Aldersgate Group, that the UK would have to be 'better and smarter' on energy projects.

'We must develop technologies that are both green and cheap. Costs of clean energy and clean transport must continue to fall,' Rudd said. 'We need to breathe new life into the research, development, demonstration and deployment cycle.' She added that the UK had enjoyed some major successes in this area, but admitted the country did not have 'all the answers' it needed on decarbonisation. And, despite her department's budget being cut by 22% in November's Spending Review, Rudd said she had fought to have its innovation budget doubled to £500m over the next five years.

'The best way to deliver action on climate change is... by using the markets, using free enterprise and competition to drive down the costs of climate action and develop new technologies,' she said.

Movers and makers

Send your job moves to **editor@cibsejournal.com**

Rob Simmonds

Rob Simmonds has been promoted to associate partner at Taylor Project Services (TPS), after six years at the company, working as a senior mechanical engineer. TPS Building Services Consultants welcomes the appointment as a reinforcement of their business in the commercial, retail, health and education sectors.

Aaron Swain

Building services contractor LJJ has appointed Aaron Swain to the new post of mechanical operations manager at its central office in Solihull. Swain will oversee the company's contracts managers. He joins LJJ from a major mechanical and electrical contractor, where he progressed from project manager to operations manager during a 13-year tenure.

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Free sessions on CIBSE membership

CIBSE is holding free membership and registration briefings across the UK and Ireland this year.

These sessions will offer help and guidance on applying for, or upgrading, your membership of CIBSE, as well as information about the requirements and interview. You will also be able to discuss your application with CIBSE staff and registered interviewers.

The sessions will focus on different areas of the application process, such as preparing the engineering practice report.

CIBSE will also be holding free membership webinars each month – so, if you can't attend a briefing, you can log on at your desk or from home.

Sessions are taking place in February, March, April and May. For full details and to book a briefing or webinar, visit **www.cibse.org/briefings**

Travel bursary up for grabs

The Ken Dale Travel Bursary 2016 is open for entries. The award offers between £1,500 and £4,000 to CIBSE members – in the developmental stage of their career – who wish to spend three to four weeks abroad researching aspects connected to their field of work.

Last year's winner, Luke Ramsay, travelled around North America and south-east Asia to investigate 'Low carbon cooling in data centres: barriers and opportunities'.

Ramsay said: 'The bursary is an amazing opportunity to experience engineering in lots of different contexts. I visited some world-class projects and met inspiring people. It's given me new perspectives in my work and provided me with an opportunity to develop a new specialism.'

The closing date for entries is 15 April. For more information, visit **www.cibse.org/awards**

BIM product data template initiative to benefit industry

Templates developed to support the evolving needs of digital construction industry

A joint initiative between CIBSE, the Construction Products Association (CPA), BIM4M2, and National Building Specification (NBS) has been launched to provide consistent product data parameters and templates. These will enable manufacturers to prepare their product data in readiness for the government's April 2016 BIM mandate.

Building and infrastructure manufacturers will have free and ready access to product data parameters and templates, developed in collaboration, that are relevant to their products.

By using these templates, they will be able to supply product information in a form that aligns with the UK's Level 2 BIM requirements.

The templates currently identify the minimum product data requirements for Level 2 BIM. They will eventually be extended to include all aspects of a product's life-cycle and operational performance, building on the work so far completed by CIBSE, BIM4M2 and others.

Extended templates already developed by CIBSE can be found on the CIBSE Knowledge Portal. Common product data parameters will enable easier development of further templates.

The benefit of this initiative to the supply chain is significant. The availability of product data in a structured form equips designers with the information they need to create project information models reliably and accurately. This will lead to the provision of higher quality project data that can be checked and validated by clients, designers and contractors.

Through this joint initiative, all templates will be maintained and developed to support the evolving needs of a digital construction industry, and to ensure product parameters align with the requirements of relevant standards.

The templates and common product data parameters will be made available on both the CPA and NBS BIM Toolkit websites, as well as on the existing CIBSE website. The current product data templates can be found at **toolkit.thenbs.com/articles/pdts**

Organisations within the initiative will engage with other industry groups, including the wider BIM4 Communities and trade associations, to ensure industry product data requirements continue to be supported.

To view the product data templates (PDTs) on the CIBSE Knowledge Portal, visit **www.cibse.org/knowledge**

Capital's businesses rise to London mayor's energy challenge

More than 100 of London's leading businesses took part in the 2015 Mayor of London's Business Energy Challenge, sending in data for a total of 1,600 buildings.

Together, they saved enough energy to power more than 24,000 London households in the capital for a year. This equates to a reduction in carbon emissions from energy use of more than 188,000 tonnes across their London locations in 2014/15.

Sara Kassam, head of sustainability development at CIBSE, judged one of the awards, and the energy consumption of the entries was analysed by a CIBSE-funded researcher at University College London.

The scheme, organised by the Greater London Authority, promotes energy efficiency in businesses and, each year, participating firms – including shops, restaurants, banks and offices – submit the annual energy consumption data of their estates.

The winners of the 2015 challenge have now been announced. For more information on the challenge, and to view the winners, visit **www.london.gov.uk/bec**

Fire performance study wins prize for Uclan MSc student

- **Garcia wins £1,000 plus a 12-month licence for the IES VE-Pro software suite**

Eugenio Garcia, who studied for his MSc in fire safety engineering at the University of Central Lancashire, has won the 2015 Building Simulation Group (BSG) Student Prize with his report *Advanced computational simulation of fire performance and external spread on multi-storey façades*.

His research was commended for its clarity, the use of software with validation, and its potential guidance for adopting the approach for most buildings at risk of fire. Garcia won £1,000, a 12-month licence for the IES VE-Pro software suite, and a place on one of the IES training courses, worth more than £7,000.

The two highly commended runners-up each took home a £250 prize. Daniel Fosas de Pando, who studied for an MSc in architectural engineering at the University of Bath, conducted a project entitled *Does improving the building fabric increase the risk of overheating in mid-terrace dwellings in the UK?*

Antonella Emili, who studied for her MSc in civil and architectural engineering at the University of Cambridge, entered her dissertation, *Assessing the thermal performance of glazed curtain wall systems*.

The 2015 Building Simulation Group Student Prize, sponsored by Integrated Environmental Solutions, focused on MSc projects involving the application and development of advanced simulation techniques and/or software, for predicting the performance of buildings and environmental control systems. The annual contest is open to UK and overseas students. For more information visit **www.cibse.org/bsg**

From left: Dr Zsolt Bako-Biro (retiring Building Simulation Group secretary), Professor Hazim Awbi (BSG chair), Eugenio Garcia (prize winner), Antonella Emili (highly commended), Daniel de Pando (highly commended), Professor Darren Woolf (BSG vice-chair) and Dr Naghman Khan (new BSG secretary)

Piloting Dissertations for Good

Seven civil engineering students, including four MSc and three BEng students, have undertaken CIBSE projects relevant to the enhancement of CIBSE guidance and resources, as part of the Dissertations for Good pilot scheme.

The scheme has involved CIBSE working with students at the University of West London to develop dissertations in the following areas: the environmental performance of refurbished buildings; the comparative study of weather files and buildings; and the critical review of current climate change information for building adaptation.

The pilot scheme, run by the National Union of Students (NUS), works to match students who want their dissertations to contribute to social, economic and environmental good with like-minded organisations.

It also helps students carry out meaningful research that has a practical application.

CIBSE's involvement with the Dissertations for Good programme has led to further collaboration with the University of West London. This includes a PhD sponsorship to look at the design of buildings for extreme weather events – research that will contribute to developing practical guidance.

Being involved in the NUS pilot has allowed CIBSE to give students valuable experience in working on practical issues that have direct applications to industry, while also building strong collaborative relationships for the institution.

On your marks... Ready Steady Light!

The 2016 Ready Steady Light competition is now open for entries. The annual Society of Light and Lighting (SLL) event, in partnership with Rose Bruford College, will involve 14 teams competing to design and set up temporary exterior lighting installations, with limited equipment and only 180 minutes in which to do it.

Returning to basic engineering and design, teams are tasked with lighting their site in its natural state with the equipment provided. Each team should be led by an SLL member, and only one team per organisation can enter.

The event takes place on 22 March, at Rose Bruford College, Sidcup, and the public can view the installations from 6pm-8pm. To enter your team, visit **www.cibse.org/sll** by 1 March.

Apply now for research bursary

Applications are invited for the 2016 Jean Heap Research Bursary, which makes available up to £2,000 to help fund research projects.

The bursary was set up in 2014 as a tribute to the commitment to lighting research and education that Jean demonstrated within the Society of Light and Lighting (SLL), and throughout her career in the lighting industry.

The panel is looking for a specific lighting study or piece of research designed for the benefit of the industry and SLL members.

The bursary is open to everyone with an interest in lighting, and applicants are asked to outline their proposed research project – including the specific topic to be researched, the methodology, timescale and aims and objectives.

Applicants should also outline why they need further funding, and how the additional funds will be used.

The deadline for applications is 1 April. For more information visit **www.cibse.org/sll**

New members and fellows

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Choi, Chi Hung
Chai Wan, Hong Kong

De Wilde, Pieter Jacobus Cornelis Jan
Plymouth, United Kingdom

Eftekhari, Mahroo
Loughborough, United Kingdom

Healy, David Patrick
London, United Kingdom

Hui, Chi Kin
Kwai Chung, Hong Kong

Hung, Wing-Hing Jacob
Mong Kok, Hong Kong

Keane, Thomas
Templemore, Republic of Ireland

Kumari, Kavita
London, United Kingdom

Lee, Pak Wing
Kowloon, Hong Kong

Lin, Siu Hung Wallace
Kowloon, Hong Kong

Parsley, Duncan Edward
Welwyn Garden City, United Kingdom

Paxton, Gary Ronald
Hornchurch, United Kingdom

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Meath, Republic of Ireland

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London, United Kingdom

Chilvers, Simon Thomas
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Chockalingam, Suresh
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COLT

Feedback

A reader argues that not all software can save energy, and CIBSE LinkedIn Group members debate causes of overheating

Access all areas

Isn't modern technology great? With the latest app heralded by my heating supplier, I can now switch on my heating even when I am not at home! But, wait, wasn't this supposed to save energy? How will we do that by heating a building we are not occupying? And once the app is available, people will play with it, leading to incorrect settings and excessive energy use. Engineers need to stop and think about the application of new technologies.

I once fought a tough battle trying to get a manufacturer to make his boiler data fully transparent to a BMS. It's on a need-to-know basis, he contended. The last thing he wanted was open access for all to adjust safety overpressure and overtemperature settings, potentially endangering plant and people.

I learned that only qualified engineers should access certain items, or system settings will be changed from their optimum by those not suitably trained. Just because the software guy can implement it, does not mean it is good for building services. Engineers must take an active role in deciding what software should be implemented to access or control building services. Reducing systems access and complexity can actually improve a building's carbon footprint, which is the engineer's overall objective.

Charles Dunn MCIBSE

CIBSE LinkedIn Group asks whether insulation is linked to overheating

Jason Lloyd Brooks

Recent media coverage has implied that residences designed to high energy efficiency standards are the main reason for overheating. The truth is far more complex, especially when building form and orientation, thermal mass and the amount of glazing in new homes also affect overheating risk.

JUERGEN FAELCHLE / SHUTTERSTOCK

Is it right to blame insulation for our overheating woes?

Simon Owen

Making sure the right information is out there has to be the way forward. The removal of government encouragement through higher efficiency standards does nothing to help the situation. More Passivhaus and low energy buildings in the mainstream will help.

Steve Johnson

Windows need to open sufficiently to achieve adequate ventilation and prevent overheating. They often don't because of high noise levels or safety concerns.

Picture a balance beam, with heat gains on one side and heat losses on the other. If these are balanced, the building won't overheat. If you increase insulation without providing additional ventilation, you will get overheating.

Ian Knight

Exceeding a required temperature in a space is a balance between the internal gains, solar gains, ventilation gains/losses and fabric losses/gains. While it is not right to blame excessive insulation alone, building fabric is a major element in a building's ability to lose or absorb excess heat. The move to lightweight, highly insulated dwellings means a major mechanism for delaying heat gains, or allowing better heat loss, has been lost.

> Just because the software guy can implement it, does not mean it is good for building services

Mike Barker

It should be a trade off in terms of price and performance – it may even be better to spend money on PV and batteries in the basement instead of insulation. This microgrid can drive fans in summer and heat pumps in winter, and the TV, Wi-Fi and kettle when the grid is down. The idea of variable (dynamic) insulation afforded by a thick curtain and pelmet – or removable window duvet – should also be explored.

Dan Lash

All insulation does is increase the resistance to the transfer of heat across a construction. During the hottest spells, a well-designed space will be cooler inside than outside. This means the insulation becomes beneficial in reducing the transfer of heat from outside to inside.

Ian Knight

The backlash is because people now overheat in new buildings when there is no cultural experience of this happening in less well insulated dwellings. They add two and two and get five.

John Hefford

There's nothing wrong with architects designing using Passivhaus principles, but problems can arise when they pick and choose which principles to apply. Without a Passivhaus consultant, they are at risk of designing a building that overheats.

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, 275 Newmarket Road, Cambridge, CB5 8JE, UK. We reserve the right to edit all letters.

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FAN LAWS

The Eco-design Framework Directive enables the EU to set energy efficiency standards for ventilation units in a new regulation that came into force on 1 January. **Hywel Davies** explains the new rules

The Eco-design Framework Directive 2009/125/EC, also known as the ErP or EuP (Energy related or using Products) Directive, provides the EU with a legislative mechanism to set mandatory minimum energy performance requirements for energy related products.

The directive sets a framework for identifying appropriate products representing significant volumes of sales and trade, with a significant environmental impact and offering significant potential for improved environmental impact at reasonable cost. Where the energy saving potential and market size justify it, specific implementing measures are developed.

The European Commission (EC) has identified 54 product groups under the EuP, including boilers and water heaters, for which the new rules came into force in September 2015. It also includes light sources, pumps, fans, electric motors and refrigeration equipment, covered by regulations going back to 2009.

There are draft regulations for room heaters and warm air central heating systems. For more on these visit **www.cibse.org.uk**

The latest Regulation and cause of much new year grief is 'Commission Regulation (EU) No 1253/2014 of 7 July 2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to eco-design requirements for ventilation units'.[1] This came into force on 1 January.

According to the EU 'ventilation units [account for] 2% of total EU electricity consumption, making them the most important electricity consumers in the building environment after lighting, heating and cooling. The scope for further reducing the energy consumption of ventilation units is substantial'.[2] The EU also provides an FAQ page for Regulations 1253/2014 and 1254/2014.[3]

While some manufacturers appear aware of the new rules and their impact, others in the MEP sector are not.

The new EU Regulation has also triggered amendments to the Eco-design for ErP Regulations 2010 (S.I. 2010/2617) and the Energy Information Regulations 2011 (S.I. 2011/1524).[4] The Explanatory Note prepared by DECC at the end of the published Regulation states that the amendments modify the 2010 and 2011 legislation and also partially implement elements of two other EU measures, as follows:

a) Regulation 2(2) and (3) adds two new products to Schedule 1 (declaration of conformity) to the 2010 Regulations – (i) small, medium and large power transformers to apply from 1 July 2015 (ii) ventilation units to apply from 1 January 2016.

b) Regulation 3 adds residential ventilation units to Schedule 1 (EU measures) to the 2011 Regulations to apply from 1 January 2016.

The note adds: 'A full regulatory impact assessment has not been produced for this instrument as no impact on the private or voluntary sectors is foreseen.' Based on recent correspondence, this may be something of a misjudgement, as the change in the rules is exercising many in the MEP sector.

> It is worth reviewing existing designs and contracts now

OLIVIER LE QUENEC / SHUTTERSTOCK

Ventilation units account for 2% of total EU electricity consumption

It is worth asking why this is causing such angst. The changes to the technical requirements, particularly the energy efficiency requirements, in Regulation 1253/2014 were first published in August 2014, with a lead in of almost 18 months.

Ventilation units may be installed by the hundred throughout a building, and are in turn connected to a whole building system of ducts and pipes. So changes to the energy efficiency requirements and specific fan powers of these can have significant implications on the overall design and performance.

A scheme may have been mid-way through installation on 1 January when the new rules came into force. Half the ventilation units may have been supplied, and the other half on order. But if they are delivered after 1 January, then arguably they must now meet the higher standard. It all depends on the definition of placing on the market.

A further impact is that a design, where the installation contract is agreed, may need revisiting to ensure the ventilation units are compliant with the new Regulation. In this case, there can be no debate about placing on the market, if the work has not yet begun.

This issue might be lurking in a contract on your desk, so it is worth reviewing existing designs and contracts now.

References:

1. Commission Regulation (EU) No 1253/2014, **http://bit.ly/1PGHMKs**
2. *Ventilation units more energy efficient and less noisy*, European Commission, **http://bit.ly/1RUUNGR** published 9 July 2014.
3. Frequently asked question to Commission Regulation (EU) No 1253/2014 **http://bit.ly/1Pqxj5w**
4. The Ecodesign for Energy-Related Products and Energy Information (Amendment) Regulations 2015, **http://bit.ly/1wa6Ndu**

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

THE ROAD TO SALVATION

Society can prevent catastrophic climate change if it harnesses the skills of engineers to build in a sustainable way. That was the conclusion of a presentation by the UK-GBC's **Cat Hirst**, in a presentation to the CIBSE Rumford Club. **Alex Smith** was there

Guests at the Rumford Club debate last month were given two contrasting visions of the future by Cat Hirst, head of learning and development at the UK Green Building Council (UK-GBC). Hirst was the guest speaker at a debate on what the future might look like in a world of advancing technology and finite resources, and she drew a picture of life in 2050 from both a negative and positive perspective.

The subsequent debate on what building services engineers could do to help steer construction to a sustainable future was a mixture of optimism that engineers could meet the technical challenges, and uncertainty over whether innovation would be stifled by an industry wary of taking risks.

In her doomsday scenario Hirst predicted life in 2050 if the world had done nothing to combat climate change. She drew attention to the 2006 Stern Report, which suggested that countries would need to spend 1% of GDP on measures to tackle the effects of climate change but said that by 2050, if nothing had been done, this could grow to 10% of GDP. She said that if nations didn't limit temperatures to 2°C above those in 1990 there were many scenarios in which temperatures could be 3-5°C higher by 2050.

In that case extreme flooding and drought would be experienced across the globe, and she predicted hundreds of millions would be displaced (climate migrants), ecosystems destroyed and species made extinct.

Hirst said there was an alternative brighter future if we heeded the current warnings on climate change and resource scarcity. She said emissions could be driven down by new ways of working, changing our relationship with food and resources, and the adoption of renewables and other intelligent technologies. Challenging 'business as usual' and renewed emphasis on people, communities, and health would be crucial in making this shift.

CHICCODODIFC / SHUTTERSTOCK

Engineers can help avoid this scenario in 2050

> What we need to do as engineers is spend a bit more time learning how to motivate

Aecom director Ant Wilson, FCIBSE, responded by saying that engineers had a responsibility to educate clients about building using more environmentally sensitive methods of construction. 'I think technology can get us through, but I think we should be educating our clients, and taking it more seriously.

'What we need to do as engineers is spend a bit more time learning how to motivate, how to mentor, and how to pass on skills,' he said.

Briony Turner, Knowledge Exchange Manager for the ARCC Network, said professional ethics render it the duty of designers to warn clients of the impact changing climatic conditions may have on their buildings and the health and wellbeing of occupants.

Some practising engineers said that convincing companies to do the 'right thing' and develop more energy and resource efficient buildings could be challenging. One said: 'Finance drives the majority of business decisions we make. What is happening today is not sustainable – it can't continue.'

He said that change could be made. 'You need engineers putting forward better solutions but it's about doing it through osmosis and marginal gains. I've sat in front of clients and said I'm going to change the world tomorrow – but when they come to sign the contract they say "I'm not going to do it. I want to sign what we had before." '

Hirst said many UK-GBC members, including major clients, were looking to the design community to lead the way and innovate, and were very open to new ways of thinking.

'All the clients we have say they want to be challenged more by the design team. The clients don't always have the skills and the foresight to develop that brief themselves. There's a huge opportunity to improve them.'

One engineer said that liability was holding people back. 'In any organisation you deal with corporate vision, then you get the grey suits who need to limit liability,' he said. 'If you quantify the liability and it becomes something acceptable then you can change.'

Others said that enlightened self-interest would ensure markets delivered low-carbon buildings in time to avoid permanently damaging the climate. 'It is common sense if you use fuel efficiently you will save money,' said one engineer. 'If you tell them you can save energy by doing things properly, you have got the accountant's attention.'

BSRIA chief executive Julia Evans said that a new generation in the workplace would have a significant impact. 'Their perspective is dramatically different. I look to create an environment where they can flourish, and I look to them to be contributing to this move towards a more sustainable economy,' she said.

The audience believed that if engineers were to make a difference they had to get their arguments across in the right way. 'If we don't communicate what is needed how can we expect the client to do the right thing?' said Wilson.

● Visit **www.therumfordclub.co.uk** for more on the Rumford Club.

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LONDON CALLING

Camden's Agar Grove estate is to become the UK's biggest residential Passivhaus project. Max Fordham's **Bertie Dixon** describes the challenges of building an 18-storey tower to the standard, and explains why the council is committed to the low energy code

DESIGN TEAM (CONTRACTOR TEAM)

- **Architects:** Hawkins Brown; Mae; (Architype)
- **Main contractor:** Hill
- **Structural engineer:** Peter Brett Associates
- **Services engineer:** Max Fordham (Robinson Associates)
- **Passivhaus consultant (Designer):** Max Fordham (Architype/Elemental Solutions)
- **Passivhaus certifier:** WARM
- **Landscape architect:** Grant Associates
- **Project manager & QS:** Arcadia

The redevelopment of the Agar Grove estate, in Camden, is not only expected to be the biggest residential Passivhaus development in the UK. It is also highly challenging for the designers involved.

As well as having an 18-storey Passivhaus residential tower on a tight inner-city site, the development is subject to environmental planning requirements that are not always compatible with Passivhaus principles. For example, heat networks might appear to be a prerequisite for large housing schemes in London, which means incorporating a network of heating pipes. The heat loss from the pipework introduces an increase in annual 'primary energy demand',[1] which is limited in the Passivhaus standard, so the project team had to work hard to come up with an ultra low-loss network design.

So, if Passivhaus can introduce tensions with London planning policy, why attempt to apply Passivhaus to 345 apartments? The drive comes from the client, Camden Council, which owns and manages the estate. It believes a Passivhaus design can reduce fuel bills and cut carbon, while minimising the council's costs of maintaining the heating system.

Michelle Christensen, senior development manager at the London Borough of Camden, explains: 'The simplicity of the concept, low maintenance requirements and low fuel costs for residents are the driving forces behind this approach, which has been integral to the proposals from the outset.'

Buildings constructed to the Passivhaus standard are designed to use the minimal amount of energy, and the focus is on minimising heat gains. Buildings must have an annual heating and cooling demand of not more than 15 kWh/m^2, or be designed with a peak heat load of 10 W/m^2. To minimise heat loss from the building fabric, the structure must not leak more air than 0.6 times the house volume per hour at 50 Pa. With such

VISUALISATIONS: FORBES MASSIE/HAWKINS BROWN

low heating demand the heat could be delivered on the ventilation air rate required for hygiene, although heating via warm air is not necessarily proscribed.

The standard is as much about comfort as it is about energy. It sets numerous standards for summer and winter comfort. Some of these are described in Table 1.

Arguably more important than the energy and comfort targets is the process of design, check and improve that is central to the Passivhaus process. It is more rigorous than conventional procurement, and this applies to design, to the manufacture of certified components, to construction and, finally, to the commissioning process.

Passivhaus has been proved, over 25 years, to produce a significantly smaller performance gap, and does not have to cost more than conventional building[1] – so why is it not more commonplace? It is hoped that Agar Grove will prove the relevance of Passivhaus in the UK, and its viability in volume house building.

The Agar Grove estate

Agar Grove was built in the inner-London borough of Camden in the 1960s, and is bounded by a busy road and two mainline railways. Its refurbishment will result in 493 new and refurbished homes, including 240 for private sale. All 345 new-build units are designed to Passivhaus standards and Code for Sustainable Homes level 4.

The project also includes a deep refurbishment of the 148-unit Lulworth tower, which will meet BREEAM Domestic Refurbishment Excellent (148 units), but not the Passivhaus retrofit standard, EnerPHit. Phase 1 includes the construction of 95 units.

Current residents will be rehoused on the site to maintain social cohesion. For the scheme to be financially viable, the housing density has been doubled to allow the inclusion of apartments for sale on the open market (see Table 2).

Design challenges

Architects Hawkins Brown and Mae were responsible for masterplanning the development, and Hawkins Brown associate Emma Lynn says designing to Passivhaus on an urban site posed some challenges.

'Building Passivhaus in the city is quite unlike building on a greenfield plot – there are myriad requirements on the building form which must be resolved,' she says.

The masterplan is based upon the traditional concept of streets and squares, adds Lynn, with an emphasis on 'creating liveable spaces between buildings and allowing people

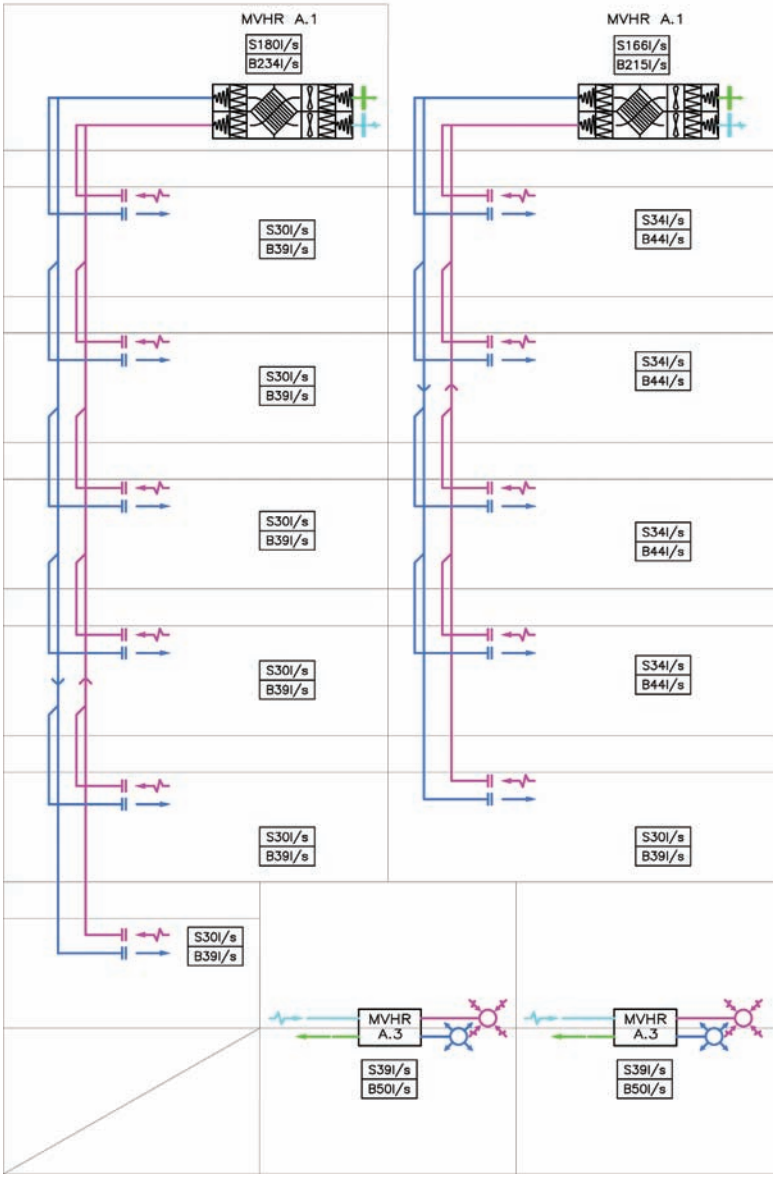
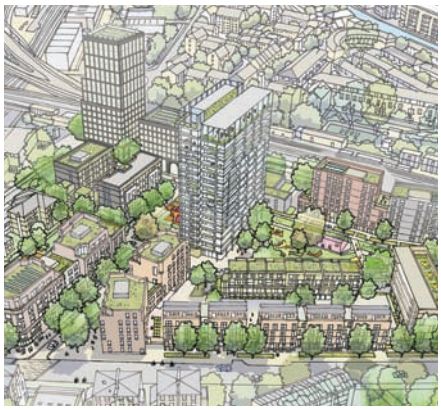


Figure 1: Schematic showing some flats with communal MVHRs and others with individual units

	Passivhaus standard	Part L1A 2013 approx
Energy requirements of the Passivhaus standard		
Heating energy demand, kWh/m²·yr	< 15	45
Primary energy load, kWh/m²/·yr	120	190
U Value for Windows, W/m²K	< 0.8	1.3-2.0
U Value for exterior shell components, W/m²K	< 0.15	0.15-0.35
Some of the comfort requirements of the Passivhaus standard		
Air quality	Good – 600ppm CO_2 above ambient	No standard
Overheating	Max 10% of the occupied year > 25°C	Max 1% >28°C
Surface temp (windows)	>17°C when -10°C outside	No standard
Surface temp	3-3.5°C below room temp.	No standard
Air-tightness, ACH @ 50Pa	0.6	0.6 - 3
Air-tightness, m³/m²·h @ 50Pa	2	2 - 10
Ventilation rate, l/s per person	8	10
Noise limit in bedroom, dBA	25	25

Table 1: Energy standards of Passivhaus compared to Part L1A 2013



FABRIC SPECIFICATION FOR BLOCK A AT TENDER (AND POST CONTRACT)

- U value wall 0.12 (0.191) W/m²K
- U value roof 0.09 (0.090) W/m²K
- U value floor 0.15 (0.269) W/m²K
- U value window[II] 0.8 (0.84-1.1) W/m²K
- U value door 1.5 (1.5) W/m²K
- Air permeability <1.2 (<0.6) m³/m²·h) @50Pa

to move across, through and within the site.'

As a result, it was not always possible to position the buildings north to south, which is the ideal orientation for beneficial controlled solar gains. To 'stitch in' the massing to the neighbouring streets, the taller buildings were placed to the south of the site, which caused some shading. This had to be taken into account when considering the lower heat gains in some flats during the winter. (See panel, 'The north-south divide').

Another challenge was the balcony design. They are often recessed to reduce visual impact on the façade and complement the aesthetics of the existing housing and maisonettes.

'This introduces complexity in the structure and associated thermal bridging,' says Lynn. 'The Passivhaus consultant and the design team resolved these tensions by using the Passivhaus Planning Package (PHPP) model rigorously and iteratively to test design choices – such as window size, U values, and M&E efficiencies – to select the most cost- and technically efficient specification.

Figure 2 shows the effect of such design choices on the heating demand in two blocks over the course of RIBA work stages 3 and 4.[III] The contractor design team have since developed this much further.

The north-south divide

In winter

East-west facing buildings have a less favourable heat-energy balance than north-south buildings in the winter. The figure below indicates that block A (north-south) met the Passivhaus standard more easily than block G (east-west). Block G started considerably above the target – the steep contours represent improvements brought about by changes in items such as window ratio and detailing, wall construction, thermal bridging, and duct length design.

In summer

It is more difficult to control solar gain in an east-west building, so the windows are made smaller while still achieving good daylighting and views. Overshading from buildings is taken into account in the modelling.

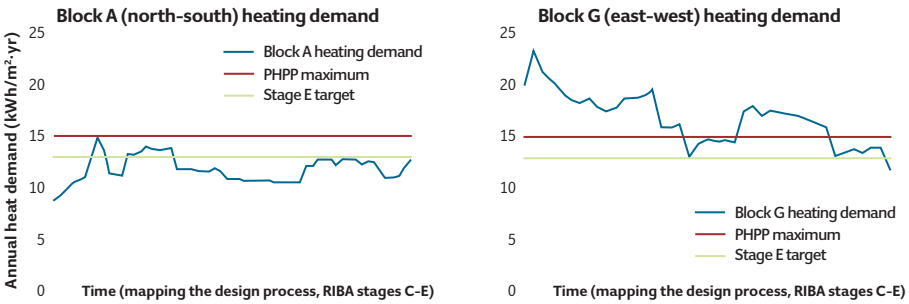


Figure 2: Diagram showing lower heat demand in block with north-south orientation

Passivhaus and other design codes

Agar Grove meets the strict requirements of Passivhaus, as well as of the Code for Sustainable Homes and other metrics of sustainability and design quality. Part of Max Fordham's role was to resolve any conflicts arising from these overlapping standards.

Planning policy in London sets challenging carbon targets, which are assessed via the 'SAP methodology' calculation. This is known to be a poor measure of performance in use[2]. SAP does not model the expected significant reduction in performance gap that Passivhaus achieves, which makes it difficult to justify the perceived increased cost or complexity. Even so, a less stringent CO_2 target than the policy was accepted by planners in recognition of the quality of the scheme.

Through iterative design, the window-to-wall ratio was set around a conservative 35%, to limit summer solar gains without resorting to solar control glass, and to limit winter heat losses. The groundfloor units are generally duplex to avoid street-level bedrooms, where occupants may not wish to open the windows at night. The bedrooms are of lightweight construction, to allow fast purging of the day's heat in the early evening.

Working with district heating

As the primary energy demand is limited by the Passivhaus standard, the designers focused on reducing the length of pipework wherever possible. The boilers are not in a single central location, as preferred by the Greater London Authority, but block by block. As well as easing the phased development, this approach reduces the required system temperature and pressure regime, and allows a reduced scale of plant and controls. It also allows more of the maintenance to be done by Camden's in-house facilities management (FM) team.

Rather than a traditional network of one riser with long lateral branches at each level, the pipes are arranged in many vertical risers. This simple change reduces pipework length considerably. By using hydraulic interface units (HIUs) , the LTHW flow and return temperatures are reduced – both are critical to reducing losses. The system was designed at 70/40°C, and the contractor team is looking to push this even lower.

Secondary benefits of this approach are lower capital and running costs, reduced risk of overheating, and reduced risk of legionella-favourable conditions in the mains water supply (as the water main takes a different route into the building from the heating mains so there is less risk of heat gain into the mains water).

Mechanical ventilation

Modern homes are 'built tight', but are not always 'ventilated right', so they end up being 'stuffy and stinky'[3]. This is often because the ventilation is not being designed, installed and commissioned properly. The scrutiny of Passivhaus addresses these issues. On Agar Grove, private-sale and duplex apartments are served by their own MVHR units, which are mounted directly onto the external wall, for efficiency. (See panel, 'External efficiency').

Social tenure flats on a repeating floor plate can be more suited to communal MVHR, with a single unit at the head of the riser serving

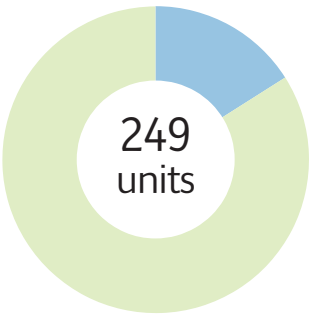
Existing site

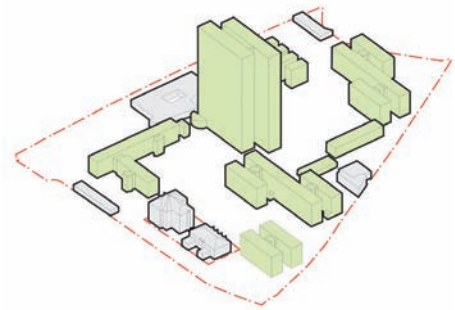
249 units

210 Camden tenants
39 leaseholders

97 units per hectare existing site density

19,432 m² existing residential gross internal area (GIA)





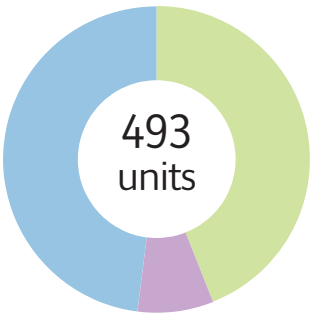
Proposed scheme

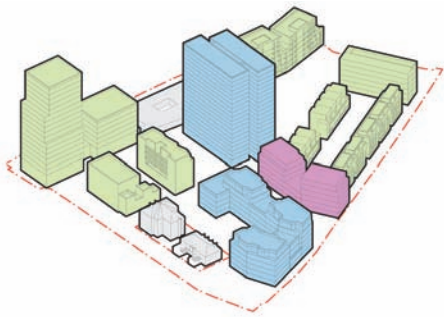
493 units

216 Camden tenants
37 shared ownership
240 private

193 units per hectare proposed site density

49,346 m² proposed residential GIA





KEY Camden residents ■ Shared ownership ■ Private – outright sale ■ Buildings not part of site to be retained

Table 2: The 'densification' of Agar Grove – how the number of dwellings will be doubled on the same site

many flats. At a marginal cost increase, or cost parity, communal MVHR offers enhanced thermal efficiency, air quality and reduced plant space within the flat. It also means simple but essential maintenance can be carried out by facilities workers, rather than by untrained residents. Impacts of communal MVHR to be considered include increased riser space, and how to provide individual control of ventilation rates. (See Figure 1).

Summertime heat purging at Agar Grove is primarily via opening the windows, and the MVHR in bypass mode provides a small contribution towards this. If it is noisy outside, opening the windows wide may cause a short-term acoustic nuisance, but once the heat is purged, the window can be returned to crack opening and it is once more comfortable. A cracked-open window provides some acoustic attenuation and background ventilation, too.

Passivhaus in UK housing

For affordable housing providers, the lower heating bills, comfort and health benefits are very attractive. Although cost trends are showing that larger Passivhaus projects – greater than 40 units – need not cost any more to construct[4], a marginal increase in the cost could be borne by these housebuilders.

When it comes to private sale, the average buyer is unlikely to be aware of the benefits, so there may be little premium value for building a new Passivhaus. However, private developers are starting to appreciate the smaller plant allocation, improved build quality and reduced landlord's overheads.

Agar Grove has been a steep learning experience for everyone. But at this early stage we feel we have demonstrated that Passivhaus can be applied successfully at a very large scale. The challenge of procurement is the management of cost and risk while achieving continuity of design. This is more tricky when there is a commitment to the rigorous and, initially, unfamiliar Passivhaus standard.

A clear brief is required, as is strong support from the client, and buy-in from the design and contractor teams. Early advice (at RIBA stage A/B) from an experienced Passivhaus designer is crucial to achieving a cost effective and successful result for all concerned.

Christensen sums up why Camden is committed to Passivhaus. 'We are determined to tackle fuel poverty and reduce CO_2 without the need for complex energy systems with high lifetime costs. This approach provides thermal comfort and air quality in a way that alternatives do not match.'

'Although this can increase the initial capital costs, Camden Council – as both developer and landlord – believes that it will see the benefits of this approach, in higher build quality and reduced maintenance costs over the lifetime of the buildings.' **CJ**

The next phase of Passivhaus

Germany is now building Passivhaus homes that produce more energy than they consume. Dr Henrietta Lynch reports

This is a special year for the 'fabric-first', low-energy, building-design standard Passivhaus. It marks 25 years since the construction of the first Passivhaus project in Darmstadt, near Frankfurt, Germany – so, to celebrate, the 2016 German Passivhaus Conference will be held there.

The first Passivhaus buildings formed part of a research project. They were rigorously tested to examine their performance, and to inform the development of design parameters and the Passivhaus Planning Package (PHPP) software. Since then, thousands of Passivhaus buildings have been constructed and examples can be found in many climates across the world.

Frankfurt is a trailblazer city for the standard in Germany. The first Passivhaus flats in the country were built there in 2003 and ABG Frankfurt Holding – a property company/housing association responsible for about a quarter, of Frankfurt homes – has delivered thousands of new Passivhaus dwellings in the city. It is also working on 'Plus-energy' designs, which exceed the Passivhaus standard and produce more energy than they use.

One such development, Aktiv-Stadthaus (pictured below), contains flats designed to Passivhaus standards, but also incorporates large photovoltaic arrays. Residents are provided with an energy budget as part of the rental cost, and encouraged to control their energy use via an app. Excess energy generated is stored in batteries, supplied back to the grid and used to power electric car sharing, housed in the basement.

Similar developments are in progress across Germany. For example, the Newton project in Berlin, which will house about 1,000 tenants, also aims to be 'Plus-energy.

For information about the 2016 Passivhaus Conference in Darmstadt (22-23 April), contact the Passivhaus Institut via **www.Passiv.de**

Notes:

I	Primary energy demand for all heat and electricity, kWh/m² floor area per yr. This is a comparable to carbon dioxide emission rate of a building.
II	Includes heat loss from frame, spacer & installation.
III	Developed design and first part of technical design stages.

References:

1 Designs for the same building task In €/m² in relation to high energy efficient additional costs, *Evaluation Of Competitions*, Ebök 2004.

2 *End of Term Report*, Zero Carbon Hub, 2014.

3 Howieson, *CIBSE Journal* October 2015.

4 Passivhaus Capital Cost Research Project January 2015, PHT.

EXTERNAL EFFICIENCY

The intake and exhaust ducts between the heat exchanger and the outside contain air at near external temperatures. If the duct is insulated at all, its U value is likely to be significantly greater than, for example, that of the wall. If the air in the duct is heated by the air in the room, it can reduce the MVHR efficiency – a 75% efficient MVHR unit could be downrated to 45%. A solution is to shorten the ducts as much as possible by locating the MVHR on the outside wall, and ensuring low U value duct insulation.

THE BALANCE OF POWER

Smart grids offer the potential for buildings to generate and store power for future use. **Mike Barker** MCIBSE, of BuildingPhysics, says it will be the job of engineers to calculate the optimum level of renewables for a building to be profitable. He considers the economic viability of incorporating a microgrid at the Durban International Convention Centre in South Africa

In the future, all electricity supply will be on a smart grid. Computer intelligence will ensure that components of the electric grid can communicate with each other to improve operations, maintenance and planning of supply.

With smart grids, smaller power sources such as renewables and battery storage – known as distributed energy resources (DER) – can be aggregated to provide buildings with power to meet regular demand. They give building owners security over their energy supply and the ability to save money through lower energy costs.

The development of smart grids and local energy generation is gaining momentum and there are examples of governments funding their advancement. For example, the state of New York is financing microgrid expansion in an attempt to reduce the number of power cuts experienced during hurricanes, such as the destructive Sandy, that hit the American East Coast in 2012.

One US microgrid vendor, which tracks power cuts worldwide, says 'an alarming increase in severe weather-related events is interrupting electric services' and that the upward trend of extended power cuts is also being caused by 'aged equipment and a loss of experienced utility workers'.

The integration of smart grids and buildings is likely to be the responsibility of the building services engineer, who will have to design and specify smart control systems to oversee the supply of electricity in developments. They will need an understanding of the relationship between the building and the national grid. The *Network Code on Requirements for Generators* sets out rules to which new generators must adhere in order to connect to the grid. (See panel on 'Existing smart grid standards').

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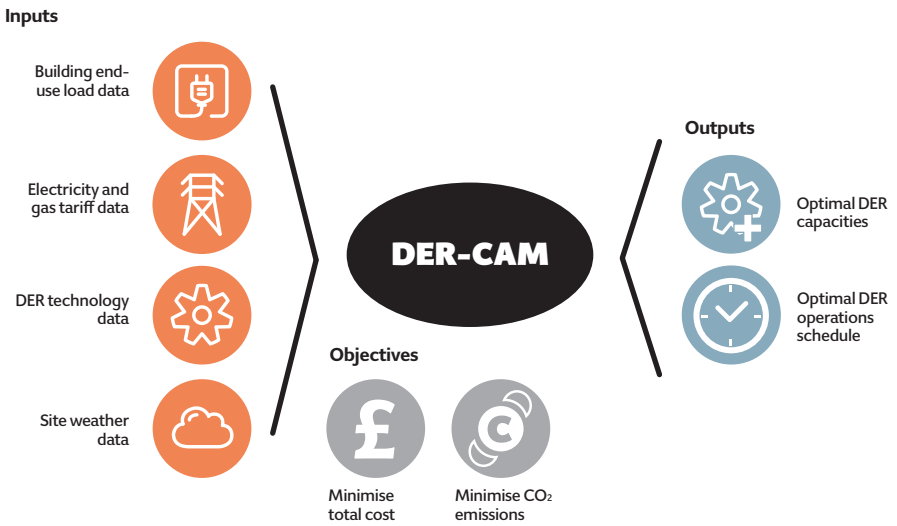


- **Investment and planning: determines optimal equipment combination and operation based on historic load data, weather, and tariffs**
- **Operations: determines optimal week-ahead scheduling for installed equipment and forecasted loads, weather and tariffs**

Figure 1: The DER-CAM model includes investment outputs and control strategies

Existing buildings can be adapted to generate their own power, and this article examines the economic viability of incorporating a microgrid in the Durban International Convention Centre, both to meet its own energy requirements and to supply power to the national grid. It is a vast 33,000m^2 event space opened by Nelson Mandela in 1997, and has hosted large, high-profile events such as the 2011 United Nations Climate Change Conference (COP17) and the Commonwealth Heads of Government Meeting.

This study considers the convention centre as it could be in the year 2022, when energy storage and electric vehicles (EVs) are expected to be both viable and commonplace.

Technical requirements of a microgrid were not considered, including stability, black starts (restarting systems after an accidental shutdown) and automatic islanding (the automatic disconnection and reconnection of a microgrid). In this case the interest was less about resilience and more about grid-tied performance, and how microgrid design can be optimised for profitability for the life of the building.

The study used the distributed energy resources customer adoption model (DER-CAM) from the USA's Lawrence Berkeley National Laboratory in California. It calculates the optimal mix of renewables and storage – in terms of minimising costs and CO_2 – based on inputs such as: building end-user load; energy tariffs; site weather data; and amortised capital and maintenance costs for any microgrid equipment investment (Figure 1).

The centre has four 1MW diesel generator sets and 180kW of traditional uninterruptible power supply (UPS). A dual 11kV redundant supply has meant the generator set has hardly

> The state of New York is financing microgrid expansion with the intention of reducing the number of power cuts experienced during hurricanes, such as the destructive Sandy

CREDIT: DANIEL & ASSOCIATES ARCHITECTS

been used and power cuts are infrequent. While the generator sets would be of use during blackouts, the DER-CAM model focused on the most profitable grid-tied solution based on renewable technologies, such as PV and electrical and thermal storage.

Assumptions were made that reflected the expected condition in 2022. This included the increased efficiency of equipment, and the lower cost of renewables and electrical storage. Goldman Sachs, for example, is predicting a 60% decrease in the cost of electrical storage by 2020.

The electricity tariff has time of use (ToU) charges for both energy and power. The tariff is weighted towards demand (power) instead of energy. Peak charges in the afternoon represent a future with high levels of renewables and EVs on the grid and are based on scenarios predicted for California. No feed-in tariffs (FiT) or net metering are considered because of the uncertainty of government policy (see panel 'The risks of relying on feed-in tariffs').

The building has only cooling throughout the year, and the existing ice storage system would be resized as required by DER-CAM. Typical load profiles were specified for three circumstances – event breakdown (dismantling) days, typical event days, and high load event days. Weather files include insolation.

Outcomes and predicted savings

The modelled results show a 12% total annual saving compared with a grid-connected baseline over a 20-year period. The operation of the microgrid on a typical event day shows load shifting, and the building as presenting a well-behaved load to the grid, which has further value (see Figure 2).

Initial modelling efforts explored the possibility of operating off the grid, with the grid as a backup. DER-CAM results revealed that even with future PV energy efficiencies of 30% and the lowest predicted battery costs, there would never be enough roof area to power the building, especially once electric vehicles were introduced.

EVs are an attractive source of electrical energy storage and can be characterised for inclusion as intermittently available mobile storage devices; their capital cost is not part of the building expenditure.

Only one benefit-sharing mechanism was modelled. Predicting the movement of EV owners is complex, so DER-CAM uses a statistical approximation of a fleet of vehicles.

Vehicle-to-building (V2B) economics focused on trading the value of undercover parking with that of energy exchange interactions. A V2B management system will identify vehicles that in the building until at least early evening. These will be topped up as they arrive, in anticipation of later use.

No vehicle will have its battery drained beyond a set value – minimum state of charge (SOC) disconnect – ensuring no EV owner

Optimal dispatch

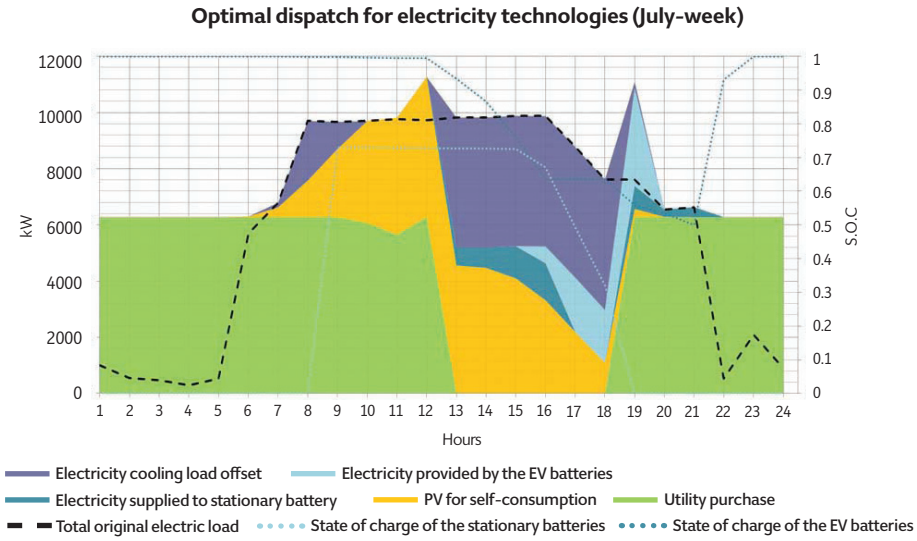


Figure 2: Optimal dispatch of resources for a typical event day.
NB no power is needed to be drawn from the grid during peak hours

The risks of relying on feed-in tariffs (FiT)

Building owners need to understand that FiT and net metering (NM) can disappear at the stroke of a policy-maker's pen and that they are probably better advised to focus on self-consumption as a long-term strategy.

You may have heard that you can profit by selling PV energy back to the national grid or your municipality. Before you get too excited, though, remember the tomato story.

You grow tomatoes in your garden. Depending on the season, rain and the birds, you will, at times, have more tomatoes than you need. Why not trade them with your friendly supermarket? After all, it sells tomatoes all the time and you often buy them there when your crop falters.

So, you offer to trade them in exchange for an equal amount of tomatoes to be collected the next month. The supermarket manager will refuse, pointing out that he buys his packaged tomatoes via a supply chain that guarantees both quality and supply, at a wholesale price far below the retail price for one.

He suggests you bottle the spare tomatoes and use them at a later date. If you need fresh tomatoes at a moment's notice, his supermarket always has them in stock. The very same economics holds for electricity.

In an ideal world, the magical grid will have infinite capacity and be run by a benevolent charity willing to take your meagre amounts of self-generated energy at a moment's notice and with fabulous reward (FiT) – or, at the very least, in equal exchange for electricity whenever you needed it in the next 12 months (NM).

In the real world, a neighbourhood full of buildings festooned with PV that produce excess energy in the middle of the day may find the grid unwilling to pay the retail rate for that energy.

More so, in the real world, the ill–timed contribution from such buildings could be turned away, and any self-generated excess will have absolutely no value.

You would be far better off if you could store that energy (literally) for a rainy day? Time to start thinking large-scale energy storage. The real advantages of battery power are not just the financial benefits, but the need to be independent and the ability to control one's future.

is left stranded. EVs arriving with depleted batteries can buy energy, but this is a separate business case and was not considered.

It was assumed that a maximum of 20% of 1,000 parking bays would have EV charging stations and would participate (see Figure 3).

DER-CAM selected the following investments as optimum:

- PV installation = 6.1MW
- Ice storage installation = 34,000kWh
- Electrical building battery storage = 12,000kWh
- EV aggregate storage = 11,400kWh

The building battery was forced to operate with a minimum discharge level of 50% so it could act as a UPS. The ice storage system played a major role in shifting the cooling load into the night, with the two electrical storage batteries supplying power once the PV contribution reduced at the end of the day. Battery storage will also allow for PV smoothing (compensating for lower PV power generation during cloud cover).

The electric vehicle manufacturer Tesla laid down a challenge last year. It's CEO, Elon Musk, announced electrical energy storage batteries for buildings and, more than that, set a benchmark upper-bound price that looks tantalisingly affordable.

This could be a tipping point for electrical energy storage in buildings, so it is appropriate to debate how buildings of the future will work, and how best to plan for unavoidable disruption.

A few decades ago, a top quality building had marble tiles and a piano in the foyer; next it was high-speed internet access. Now it will be a microgrid with its own energy generation and storage resources. Prospective tenants will ask the landlord: 'Are batteries included?' **CJ**

Battery storage

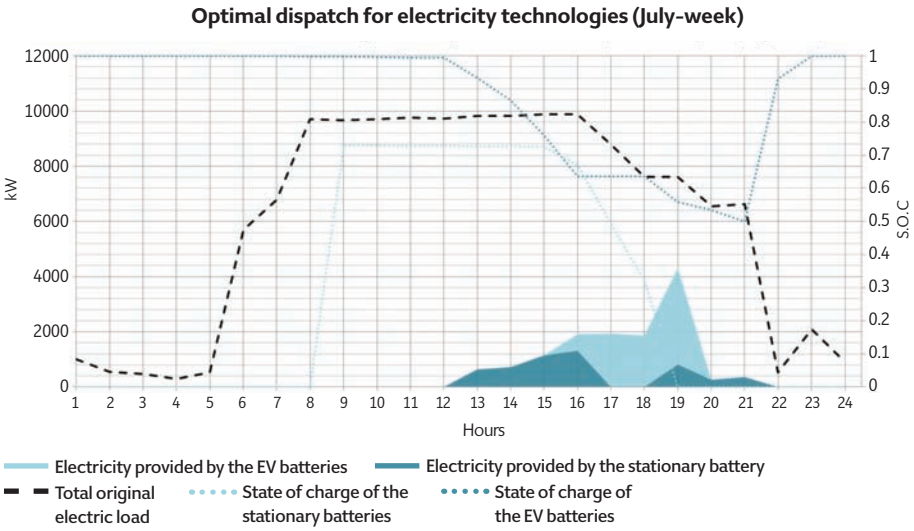


Figure 3: Contribution and state of charge of the storage resources

Existing smart grid standards

Standard	Organisation	Status
WG C6.22 – Microgrids Evolution Roadmap	CIGRE	< 2014
EN 50438:2013 – Requirements for the connection of micro-generators in parallel with public low-voltage distribution networks	CENELEC	2013
IEC/TS 62898-1 – Guidelines for the general planning and design of microgrids	IEC	> 2017
IEC/TS 62898-2 – Technical requirements for operation and control of microgrids	IEC	> 2017
IEEE 1547.4 – Guide for design, operation, and integration of distributed resource island systems with electric power systems	IEC	2011
IEEE 2030.2 – Guide for the interoperability of energy storage systems integrated with the electric power infrastructure	IEEE	2015

References:

1 Arup's five-minute introduction to microgrids can be downloaded from **bit.ly/1OomOiq**

2 Durban ICC floorplan **bit.ly/1SrwaRJ**

3 DER-CAM, Grid Intergration Group, Berkeley Lab, **http://1.usa.gov/1ZvIgsh**

MIKE BARKER is a consulting engineer at BuildingPhysics (South Africa)

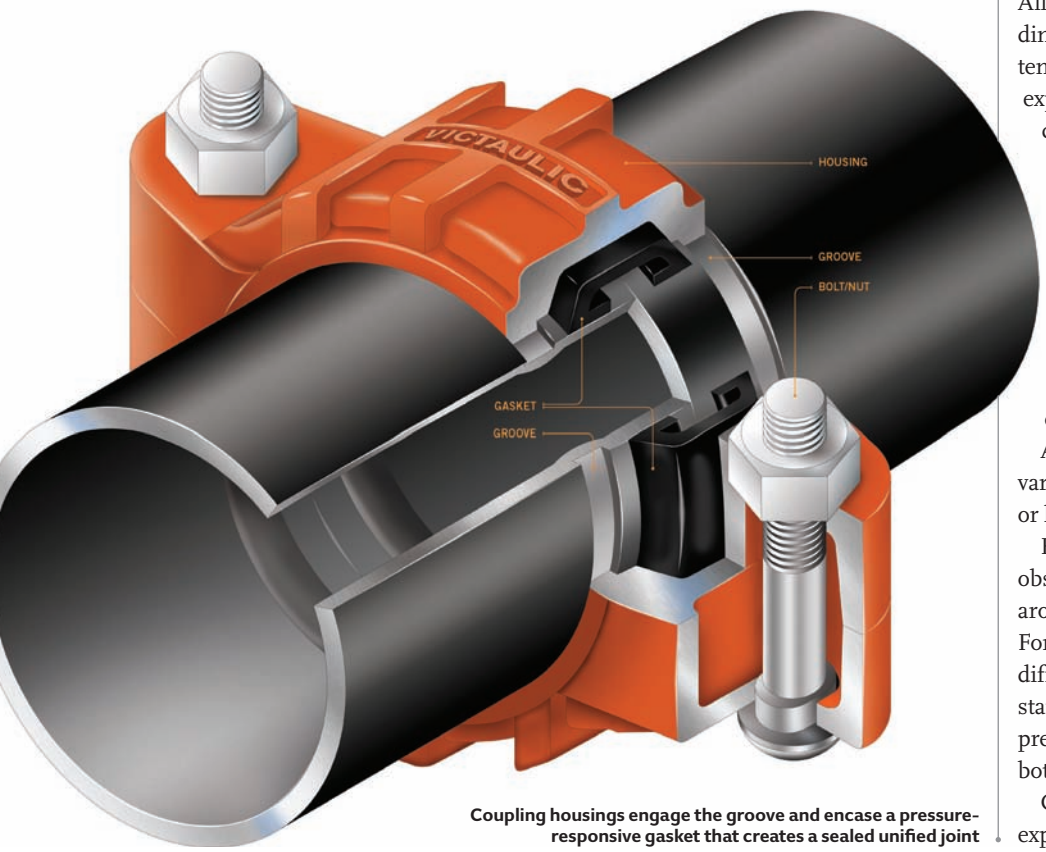
PIPEWORK GETS A GROOVE ON

A grooved pipe-joining system is one method of accommodating thermal expansion and contraction in HVAC systems. Victaulic's **Larry Thau** explains the technique's design benefits and mechanical advantages

The key to effectively accommodating thermal expansion and contraction in a building services system is to allow the predictable, controlled movement of piping. This can be done in a variety of ways, and the selection of a specific method depends upon the engineer, the type of piping system and the project parameters.

Inadequate accommodation of this movement can result in business risks caused by excess stress on the piping system, including: increased incidence of ruptures and leaks; increased stress on boilers, chillers, valves and other equipment and components; and increased downtime and labour expenses. A grooved pipe-joining system is one way of accommodating thermal expansion and contraction. It reduces stress on the piping system and provides a more compact, easy-to-inspect, and productive method of installation over other pipe-joining methods, such as welding or flanging. In addition, with the grooved method, all sealing elements are combined within a metallic housing.

> Flexible couplings do not automatically provide for expansion or contraction of piping. The designer should always consider the best setting for pipe end gaps



Coupling housings engage the groove and encase a pressure-responsive gasket that creates a sealed unified joint

Stresses on piping

Thermal transients may impose stress on a piping system, as the pipe grows when heated and contracts when cooled. All materials, including pipe, experience dimension changes as a result of varying temperatures and their coefficient of expansion. This often occurs at directional changes in the pipework.

'Bowing' can also develop at the mid points of long, straight pipe runs, resulting in stress on the piping system and equipment.

When a system is subjected to changes in temperature, it may experience horizontal movement, vertical movement and angular deflection simultaneously.

Additional strains on the piping system vary based on whether the piping is vertical or horizontal.

For horizontal piping, the major obstacles are typically the space constraints around the length and turns of the pipe. For vertical piping, considerations are different, and should involve dynamic, static and elevation head calculations of the pressures and loads that are exerted on the bottom portion of the pipe.

Carbon-steel pipe will experience thermal expansion or contraction at a rate of 1.5mm

for every 10K change in temperature, for each 10 metres of pipe. This puts the piping in a condition of stress, with potentially damaging reactive forces on components or equipment.

The forces generated during this thermal-dimension change are often significant, and the movement must be accommodated and controlled to prevent transmission of these stresses throughout the piping system.

Grooved solution

Grooved mechanical couplings enable movement in the pipe via design of the components. The dimensions of the coupling key are narrower than the groove in the pipe, allowing room for the coupling key to move in the pipe groove.

Additionally, the width of the coupling housing allows for pipe-end separation. This leaves room for controlled linear and angular movement. The mechanical coupling remains a self-restrained joint, and the unique pressure-responsive design ensures sealing even under deflection and pipe movement. (See panel, 'What is a grooved pipe joint'.)

Grooved mechanical couplings are an alternative to welded U-shaped expansion loops, welded offsets, expansion joints and rubber bellows. These couplings are easier and faster to install, and accommodate movement within the design capability of the coupling.

Nonetheless, this takes place within the product's 'free range of motion'. Consequently, piping-system movement – caused by thermal expansion and contraction – can be accommodated in smaller spaces, with low stress on the components.

There are four common methods for accommodating thermal pipe movement in a grooved system:

- Providing an expansion joint using grooved mechanical pipe components
- Allowing the system to 'free float'
- Using the linear movement/deflection capabilities of flexible grooved couplings
- Creating an expansion loop using grooved mechanical components.

The method selected is dependent on the system type, the scope of the project, and the engineer's preference.

Using expansion joints

Expansion joints are devices that can be compressed or expanded axially, and are generally the most costly alternative for accommodating thermal movement. A welded expansion joint flanged into the system requires regular maintenance. More cost-effective expansion joints use grooved mechanical couplings and specially grooved, short-pipe nipples with flexible couplings placed in long straight runs of pipe – these are pre-set to allow the required amount of contraction and/or expansion.

Axial movement can be adjusted by simply adding or removing couplings. When a series of flexible couplings are installed, the resulting grooved expansion joint will further protect equipment by reducing vibrations and stresses in the system.

Whether using speciality expansion joints or a grooved expansion joint, the adjacent piping must be properly guided (as shown in Figure 1) to ensure the movement is directed into the device and no lateral movement is experienced.

Grooved expansion joints may be used as flexible connectors; however, they will not provide full expansion and full deflection simultaneously. Expansion joints installed horizontally require independent support to prevent deflection, which will reduce the available expansion.

Flexible grooved couplings for linear movement and deflection

Grooved mechanical couplings are an alternative to welded U-shaped expansion

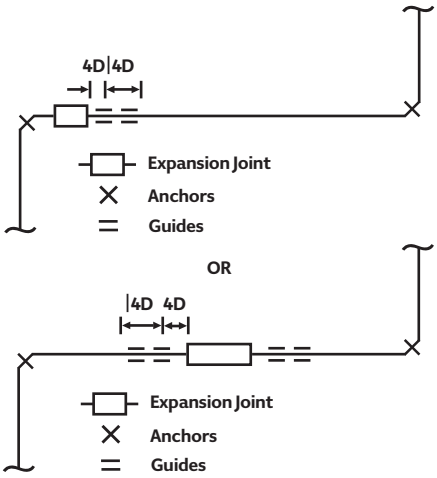


Figure 1: Design ensuring movement is directed into the device and no laternal movement is experienced

A series of flexible mechanical couplings

How the joint is made

The groove is made by cold forming or machining a groove into the pipe ends.

A gasket encompassed by the coupling housing forms a seal on the two pipe ends, and the key sections of the coupling housing engage the grooves.

The bolts and nuts are tightened with a socket wrench or impact wrench. In the installed state, the coupling housing encases the gasket and engages the grooves around the circumference of the pipe, to create a leak-tight seal in a self-restrained pipe joint.

There are two basic coupling styles that can be used on grooved pipe:

- Flexible couplings allow a limited amount of linear and angular movement
- Rigid couplings do not allow movement at the joint .

Flexible grooved mechanical couplings allow controlled linear and angular movement at joints

> Standard cut-grooved pipe will provide double the expansion and contraction capabilities of the same size standard roll-grooved pipe

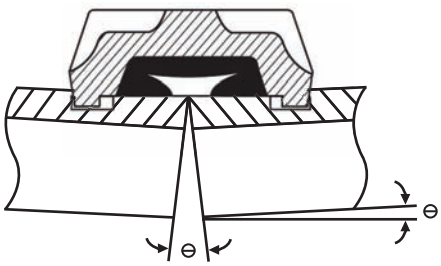


Figure 2: The angular deflection available at a flexible grooved pipe joint is useful in simplifying and speeding installation

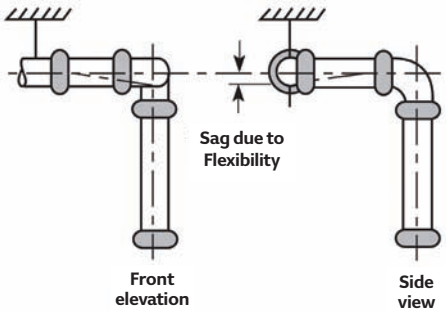


Figure 3: Sag due to flexibility

loops, welded offsets, expansion joints and rubber bellows. Associated with a free-floating system, flexible couplings are used in piping systems to accommodate piping thermal growth – without the need for any additional components or piping configuration.

Flexible grooved-type couplings allow angular flexibility and rotational movement to take place at joints. These features offer advantages in installing and engineering piping systems, but must be considered when determining hanger and support spacing.

As illustrated in Figure 3, it is obvious that this system would require further hangers – or use of a rigid coupling – to eliminate the drooping of the pipes that would occur.

Hanger positions must be considered in relation to the angular and rotational movement that will occur at joints.

Flexible couplings can allow linear movement, so pressure thrusts must be taken into account. Considering this will allow the pipe ends to move to the maximum extent allowed by the coupling – this would have accumulated at the end of the system if the joints had been installed fully compressed or only partially opened when pressurised.

By using flexible couplings at changes of direction, and directing the movement toward the directional change with properly placed anchors and guides, movement is accommodated by the joining method itself. This method also produces little or no additional stress in the system, unlike a welded expansion loop.

Flexible couplings also can be used strictly for their axial-movement capabilities. In this case, straight runs are anchored on each end and the piping is guided at every other length. Each flexible joint is pre-gapped – either fully gapped or fully closed/butted – at installation, to ensure that there are enough couplings to accommodate the expected expansion and/or contraction.

Flexible grooved-type couplings allow angular flexibility and rotational movement to take place at joints. In order to determine the appropriate number of couplings to use, the designer must compute the change in the linear length of the piping system by taking into account the length and size of the system, and maximum and minimum operating temperatures.

Where full linear movement is required, a grooved expansion joint can be used, but joints that are fully deflected can no longer provide linear movement. Partially deflected joints will enable some portion of linear movement.

Standard cut-grooved pipe will allow for double the expansion and contraction – or deflection – capabilities of the same size standard roll-grooved pipe.

When considering offsets using grooved mechanical joints, the latter must be capable of deflecting sufficiently to prevent harmful bending movements at the joints. If the pipes were to expand because of thermal changes, then further pipe growth would occur at the ends.

Flexible couplings do not automatically enable for expansion or contraction of piping. The designer should always consider the best setting for pipe-end gaps. In anchored systems, gaps must be set to handle combinations of expansion and contraction. In free-floating systems, offsets of sufficient length must be used to accommodate movement without over-deflecting joints.

Summary

A grooved mechanical method can provide an efficient way to accommodate excess stress on any piping system. It eliminates incidents of ruptures and leaks because of thermal expansion, decreases the maintenance needs of equipment, and simplifies the commissioning process. **CJ**

● **LARRY THAU** is executive vice-president and chief technology officer at Victaulic

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This month: Surface water source heat pumps, water booster sets, magnetic refrigeration and roundtable on future heating

GLAD TIDINGS

Heat derived from open water sources is predicted to become an integral part of the UK's energy plan. **Liza Young** looks at existing systems featured in CIBSE's new *Surface water source heat pumps: Code of Practice*

Surface water source heat pumps (SWSHPs) are set to play an important role in the UK's future energy strategy.

The government believes they will help the UK meet the requirements of the 2008 Climate Change Act, which include reducing the UK's greenhouse gas emissions by at least 80% (from a 1990 baseline) by 2050.

Moving to a more energy efficient, low carbon economy will help the country to achieve this reduction, which is the world's first legally binding climate change target.

CIBSE's 2015 publication *Surface water source heat pumps: Code of Practice for the UK*, aims to facilitate this move towards affordable and secure heating in the UK.

As part of a package of actions to overcome barriers to SWSHP deployment, the Department of Energy and Climate Change (DECC) produced a map identifying the thermal potential of rivers, estuaries, canals and coastal waters in England.

The examples below – taken from the CIBSE Code of Practice – demonstrate how different surface water sources can be used in SWSHP systems.

Water sources

SWSHPs are not new – in 1943, the offices of Norwich Electricity Board were heated by a two-stage SO_2 compressor that took heat from the River Wensum, in Norfolk.

Today, many examples of water source heat pump systems are in use in the UK.

Open-loop systems remove water from the source and pass it through a heat exchanger inside – or very close to – a heat pump, so the unit exchanges heat with the water directly.

Closed-loop systems collect or reject heat via an intermediate heat-transfer fluid, circulated through a heat exchanger immersed in a body of water remote from the heat pump.

Sea

The Royal National Lifeboat Institution (RNLI) uses small-scale SWSHP systems at a growing number of its lifeboat stations.

The systems include a horizontal, closed loop (slinky) (see example on page 40), like the one installed under the shoreline mud on the Wirral Peninsula, and a nest of pipes within a caisson – a watertight retaining structure; both are refreshed daily by the tide.

The RNLI's open-loop installations use sea water directly – and prefabricated, standardised designs where possible – to

A slinky system at Stanwick Lakes

reduce costs, and improve the quality and speed of installation. They use the syphonic effect to reduce the pumping energy required.

Mixed technologies can also be used to overcome SWSHP installation hurdles. At Näsby Castle, near Stockholm, Sweden, for example, an open loop – abstracting water from a nearby lake – is twinned with a vertical borehole installation.

In the summer, the boreholes, depleted during the heating season, are recharged when lake water is pumped around them. This has enabled the bore field to be reduced from 80 to 48 boreholes.

Estuary

Changes in water level – either tidal or seasonal – need to be taken into consideration when using an estuary as a source.

Usually, heat pump installations are located above water level. However, Plas Newydd, a National Trust property in Anglesey, has a shoreline pump house – containing heat exchangers, pumps and strainers – that is designed to be submerged and is equipped with a snorkel.

River

At Kingston Heights, in London, water from the Thames is extracted at approximately 10°C, filtered and pumped to a plate heat exchanger, which transfers energy to a closed-loop, low-temperature distribution system.

Here, 41 Mitsubishi Electric Ecodan water source heat pumps link to this closed loop and increase temperatures to 45°C, before sending it across the development. The plant provides 2.3MW of energy to the complex.

In mini plantrooms, heat pumps increase the temperature further to deliver underfloor heating and domestic hot water (DHW) to residential apartments. Each apartment has its own control system to regulate heat inputs to the DHW cylinder and underfloor heating.

From this summer, the central plant abstraction and distribution system will also supply hot water, heating and cooling to a 145-room hotel. The heat rejected by the hotel's cooling cycle will support its hot water, before supporting residential requirements.

The system's abstraction and discharge design was based on the given flow and load requirements for the development, and on those of the Environment Agency.

Historic sonic survey information was used to gauge the depth and distance that the installation should be from the river bank to ensure optimum consistent temperatures.

Bio-fouling can be a serious issue in open-loop systems, so secondary filtration – and heat exchanger design and performance – must be taken into consideration.

At Kingston Heights, the river abstraction intake filter is mounted on a support frame with bracings and weight bias, to ensure the filter remains in the correct orientation and more than two metres from the surface.

The inlet screens have a clean calculated differential pressure (DP) of 4.5kPa per screen at full flow of 550m^3/hr. The slot velocity at maximum flow, with 50% fouling factor, is 0.135m/s.

The pressure drop and velocity are reduced by two filters being operated in parallel.

The intake filters are cleaned automatically, *in situ*, by a backwash cycle, which is triggered by increased suction pressure to the intake pumps and timed additional cycles in the operating control logic. The backwash flow is fed from the intake pumps' discharge.

Characteristics of different surface water resources

Source	Specific characteristics	Examples
Sea	● Relatively constant source temperatures ● Saline ● Stratification ● Riparian (river bank) activities can be an issue – for example, affecting submerged pipework ● Fish and other marine life, including molluscs, shellfish and crustaceans ● Storms and tidal ● Detritus, such as plastic bags	RNLI (multiple projects)
Estuary	● Temperature modified by river temperatures ● Brackish, with possibility of saline ● Riparian activities can be an issue – for example, affecting submerged pipework ● Fish and other marine life, including molluscs, shellfish and crustaceans ● Tidal ● Detritus, such as plastic bags	Plas Newydd, Anglesey, UK
River	● Temperature dependent on flow, solar radiation, water source, such as melt water or groundwater ● Fish and other marine life, including molluscs, shellfish and crustaceans ● Potential for flooding ● Riparian activities can be an issue – for example, affecting submerged pipework ● Detritus, such as plastic bags or shopping trolleys ● In urban areas, greater potential for vandalism	Kingston Heights, London, UK
Canal	● Very slow water movement, with temperatures ranging from 2°C to 25°C across the year ● Sludge and accretions ● Regular dredging and other riparian activities can affect submerged pipework ● Detritus, such as plastic bags or shopping trolleys ● In urban areas, greater potential for vandalism	GlaxoSmithKline, London, UK
Lakes, reservoirs and ponds	● Various scales and forms – for example, stream or groundwater fed, static, deep/shallow water, sediment nature, surface area ● Large variety of recharge mechanisms ● Riparian activities can affect submerged pipework ● Fish and other marine life, including molluscs, shellfish and crustaceans ● Potential for drought ● Possibility of overheating/overcooling	King's Mill Hospital, Mansfield, UK

The standby secondary filters – with filtration capacity of between 70 and 400 microns – have an integral self-cleaning process based on differential pressure monitoring.

A small percentage of inflowing water generates suction via a venturi tube, and a motor-driven revolving suction wand directs the suction along the internal length of the filter screen. This removes deposits from the inlet side of the screen.

For more on the Kingston Heights development, see the article 'A river runs through it' (*CIBSE Journal*, January 2014), which includes an interview with Chris White, managing director of building services engineers White Associates.

Canal

GlaxoSmithKline's headquarters, in London, uses a canal for cooling its data centre.

Water is abstracted from the River Brent, at a point where it forms part of the Grand Union Canal, before being pumped into an open-loop system, passing through a coarse filter and heat exchanger. The warmer water is returned to the canal via a cascade.

A closed loop, feeding a water-cooled chiller, is situated on the other side of the heat exchanger.

Lake/reservoir

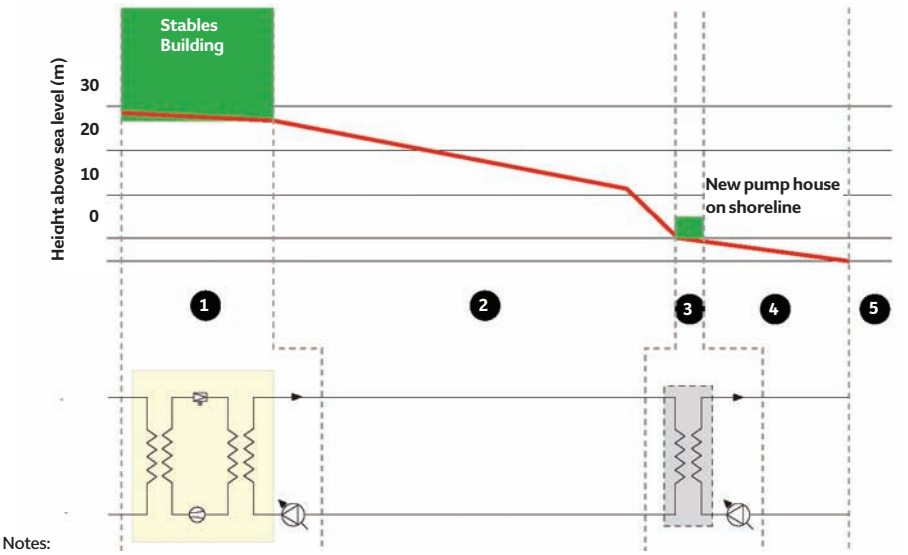
The system at King's Mill Hospital, in Mansfield, comprises 140 geo-plates arranged inside the reservoir into seven groups of 20, coupled to 42 heat pumps.

The reversible system has been designed to supply 5,400kW of cooling and 5,000kW of heating. **CJ**

- CIBSE's *Surface water source heat pumps: Code of Practice for the UK* is available at **www.cibse.org/knowledge**

> Changes in water level – tidal or seasonal – need to be taken into consideration when using an estuary as the source for a SWSHP system

Source side general arrangement at Plas Newydd, in Anglesey



Notes:
1. Stables Building at 30m above sea level contains heat pump
2. Connected by 127m of 2x160mm HDPE pipes carrying thermal transfer fluid to the shoreline pump house
3. Shoreline pumphouse contains heat exchangers, pump and strainers
4. 57m of 2x200 HDPE pipes carries sea water to the pump house
5. Intake with 200mm strainer and discharger point

Heat pumps at Plas Newydd in Anglesey

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A VERY TALL ORDER

To ensure sufficient water pressure for occupiers in tall buildings, designers have to know how to specificy water-booster sets correctly. **Glenn Miller**, of Grundfos, explains what to consider when sizing systems, and looks at the manufacturers' design for The Shard

The history of tall buildings in London dates back further than you might think. The first recognised tall structure was the 27m-high White Tower, completed in 1098, which still forms part of the Tower of London.

The London skyline only altered significantly, however, when planning laws changed in the 1960s, permitting true high-rise developments. Its first genuine 'skyscraper' – by international standards – was the NatWest Tower (now known as Tower 42), which opened in 1980 and topped 183m. This has since been dwarfed by others in the City, and tall towers have now broken out of the Square Mile to advance across the capital.

This increase in tall buildings has resulted in a corresponding demand for water-pressure boosting. The requirement for this depends on incoming pressure, static height, pipe resistance and the pressure needed from the highest outlet in the building. Applying booster sets could waste potential energy in the water supplied from the main in the street, but in many scenarios they are unavoidable.

Reduced mains-water pressure makes the requirement for boosting sets more likely. There are a number of reasons why there may be lower mains pressure. The water authority may reduce it to limit leaks in municipal networks, or there may be undersized piping between the municipal network and the building. Use is also on the rise and – combined with outdated networks and increasing amounts of horizontal development – has created ever-higher demands.

To meet these needs, there is a wide range of packaged booster-set solutions available to building services specifiers – but how do you decide which system you need for your particular application?

To make sure you are taking the correct factors into consideration when sizing a booster set, the following areas should be included within the calculation. First, the system configuration needs to be established, taking into account the volume and position of water storage – for example, basement, intermediate level, and rooftop. The next step is to define the actual flow. There are quite a few tools available to assist you with this calculation in a single-use building. The defined flow rates for each application or outlet use international standards from organisations including CIBSE and ASHRAE (there maybe opportunities for optimising pipe sizes to reduce pressure drops in buildings).

The more complex calculation in a mixed-use building can be calculated using the probability theory methods, as discussed in CIBSE Guide G, section 2. However, as has been shown (*CIBSE Journal*, April 2015, page 41) the determination of actual water demand can be challenging, and you may wish to seek guidance from a pump-booster manufacturer. They will ensure any booster set(s) meet all the requirements for a particular solution, and that they are as

energy efficient as possible. When appropriate methods are not used a common error at this initial stage is to size the set based on all the appliances running together at maximum demand. This very rarely happens and, if you base your calculations on this, the booster set(s) will be oversized.

Oversizing a booster set will result in a larger – and, so, more expensive – set being purchased than the system needs, which will also result in considerably higher energy costs over the course of its working life.

Undoubtedly, one of the key stages in booster selection is to define consumption and load profile.

The final step in the selection process involves determining the pump's duty; this is a calculation based on the static height, friction losses, and required end pressure.

Modern selection methods for pumps and booster sets are usually undertaken using manufacturers' software.

A report would normally be generated showing all sizing parameters and life-cycle cost factors; however, the sizing will only be as accurate as the information that is inputted.

> A common error is to size the booster set based on all appliances running together at maximum demand. This very rarely happens

Seven Grundfos Hydro MPC-E booster sets are fitted in The Shard

The Shard makes its point

Since it was topped out in 2010 at 310m, The Shard has dwarfed all of its neighbours and, at 95 storeys, was the tallest building in Europe until it was surpassed by the Mercury City tower in Moscow. The Shard has restaurants, retail space and a spa, as well as a five-star hotel, apartments and office space.

Such a tall building required a bespoke solution for the water boosting, bearing in mind the multiple demands placed on it by its residents, tenants and visitors.

The boosters are positioned to supply various zones within The Shard, and each zone's set was sized based on the flow and pressure requirements for that demand. They are controlled with energy efficient cascade controllers, coupled with variable speed pumps. The building had a target of using 30% less energy than comparable skyscrapers and to achieve a BREEAM rating of Excellent.

The water-booster system included single-stage standard pumps on inertia bases, multistage centrifugal pumps, and a range of booster sets, pressurisation units and ancillary equipment. Because of the requirement for low noise, inertia bases were used to minimise spurious harmonic vibrations. Anti-vibration couplings were also used on the water connection points.

The final mechanical and electrical (M&E) solution was to split the booster sets across three plantrooms – one in the basement, another approximately halfway up the structure, and the third nearer the top.

This approach combines several best-practice features, including 'building zoning' that allows for boosted water to be pumped up, and then gravity-fed back down to where it is required, to create different pressure zones. This reduces the risk of developing high pump pressure within system pipework and fittings in the lower levels of the building.

Today, there are seven Grundfos Hydro MPC-E energy efficient booster sets delivering the varied water demands in The Shard. **CJ**

● **GLENN MILLER** is product manager at Grundfos

Magnetic refrigeration has the potential to reduce energy use by 30% and requires no refrigerant. **Metkel Yebiyo** and **Graeme Maidment**, of Sirach, describe the technology, its main applications, and the challenges facing firms trying to get the concept to market

MAGNETIC ATTRACTION

At the 2015 United Nations Climate Change Conference, COP 21, in Paris, world leaders negotiated to limit global warming to below 2°C by 2100. The talks were aimed at avoiding serious climate catastrophes around the world, and participants sought to reduce greenhouse gas emissions by increasing the use of zero carbon technologies.

Magnetic refrigeration is one such emerging, innovative and potential low carbon technology. The interest in it as a new heating or cooling technology – and as an alternative to conventional vapour compression – has grown considerably over the past 15 years.

The principle of magnetic refrigeration is based on a phenomenon known as the magnetocaloric effect (MCE). Discovered by Emil Warburg in 1881, this was related to the property of exotic materials – such as gadolinium and dysprosium – that heat up when a magnetic field is applied to them and cool down when the magnetic field is removed.

It can be seen from Figure 1 that, by operating the magnet in four steps, it is possible to extract or reject heat and produce heating or cooling. The energy ($E = m.Cp.\Delta T$) generated during each magnetocaloric cycle depends on the variation of temperature (ΔT), the mass of material (m) and its specific heat capacity (Cp). This effect is maximal at a specific temperature – called the Curie temperature – of the material.

The main limitation of the magnetocaloric system shown in Figure 1 is the relatively small temperature difference that can be achieved between the cold and hot source.

Temperature exchange

A number of techniques have been used to increase this exchange, including active magnetic regenerative refrigeration (AMRR). The principle of this cycle uses a heat-transfer fluid – in contact with the magnetocaloric materials (MMC) – flowing from the cold side to the hot side when the MMC is heated (magnetised), and from the hot side to the cold side when the MMC is cooled down (demagnetised). This progressively increases the temperature difference between the cold and hot source to about 20K, making the system potentially suitable for commercial applications.

> There is no possibility of refrigerant leakage and no direct CO_2 emissions, so magnetic refrigeration fully complies with all regulations

There are various potential applications. Initial developments have been orientated towards the commercial and domestic refrigeration markets, and include display cases, beverage coolers, and commercial or domestic fridges.

However, magnetic cooling can also be adapted to other refrigeration applications, such as air conditioning (including automotive), cryogenics or in heating systems – for example, heat pumps.

The demand is likely to be driven by environmental regulations, because magnetic heating or cooling does not use a refrigerant but, instead, a heating or cooling fluid, which could be water-based. As a result, there is no possibility of refrigerant leakage and no direct CO_2 emissions, so it fully complies with all regulations, including F-Gas in Europe and Environmental Protection Agency regulations in the US.

In addition, the magnetocaloric cycle frequency is typically between 1Hz and 3Hz, so the rotation speed of the machine is slow and, therefore, very quiet compared to traditional compression systems. According to recent research, MCE is predicted

SHUTTERSTOCK/ SAKKMESTERKE

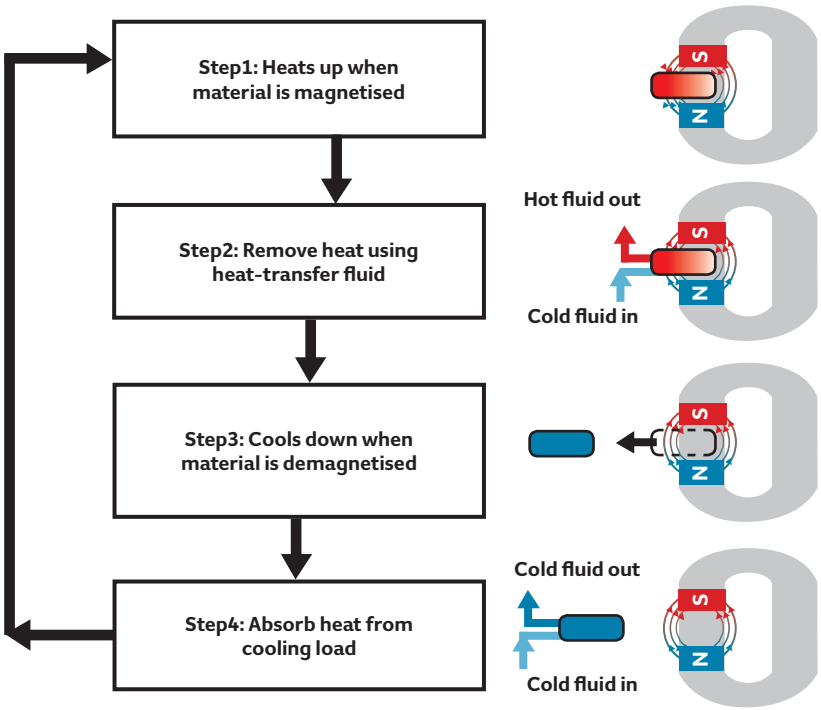


Figure 1: Schematic showing basic working principle of magnetic refrigeration

to have a significantly higher efficiency (coefficient of performance) than the present conventional methods, with the potential for a 30% energy saving.

Challenges

Even though some products have come to market, there are still challenges that need to be addressed before there is large-scale deployment of the technology. The main issue is the supply of magnetocaloric materials, which are scarce. Reducing the material content, or identifying new materials, would increase viability.

According to magnetic refrigeration engineers Cooltech Applications, the fabrication process is not yet optimised and production costs are still high. Interface optimisations (for example, heat exchangers) between the devices and the equipment to be refrigerated also need to be modified for maximum efficiency. Finally, development of prototypes for various specific applications needs to take place.

Although there is a lot of academic work by scientists and engineers at universities and research institutions worldwide, the current market development is not fully mature. Some of the companies pushing the boundaries of this technology include Cooltech Applications and Nextpac, which is working on heat-pump applications.

In 2015, Cooltech Applications said it had produced a 150-700W product as part of a refrigeration system (see Figure 2), and the first tests will be carried out at end users' sites, such as supermarkets, this year.

Meanwhile, Camfridge is involved in a large EU research project on magnetic refrigeration – visit **elicit-project.eu/** for more information.

Other multinationals working on similar technologies include Whirlpool, Electrolux, Astronautics, GE Appliances, Samsung, Erasteel, Sanden, Chubu, BASF and VAC.

CREDIT: COOLTECH APPLICATIONS

Figure 2: A magnetic refrigeration system

Verdict

Magnetic refrigeration is very promising. It is not yet ready for market, but it is a technology to keep an eye on over the next five to 10 years. Its potential to reduce energy use and operate without environmentally impacting refrigerants makes it an exciting proposition. **CJ**

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

About Sirach

This is the first in a regular series of articles by Sirach's Metkel Yebiyo and Graeme Maidment, looking at emerging heating and cooling technologies. Sirach aims to provide industry and academic researchers with the opportunity to promote new carbon-saving technology. Sirach holds regular meetings at leading universities and businesses that engage in research. On 20 April, it will visit the Centre for Sustainable Energy use in Food chains (CSEF) at Brunel University. For more information, or to be included on the Sirach mailing list, please register at **www.sirach.org.uk** or email **info@sirach.org.uk**

The general consensus of the roundtable was that collaboration is key to the success of projects

WHAT NEXT FOR **HEATING, COOLING** AND **VENTILATION**?

How does our approach to services need to adapt to tackle issues such as climate change? A *CIBSE Journal* roundtable, sponsored by Mitsubishi Electric, examined the factors influencing the design of heating, cooling and ventilating – now and in the future. **Andrew Brister** reports

As our shores get repeated batterings from ferocious storms this winter – and households and businesses suffer the misery of flooding – climate change continues to hit the headlines. In December, leaders from across the globe agreed at the UN Climate Change Conference in Paris to adopt 'a binding treaty' that commits countries to making massive cuts in their emissions of greenhouse gases, such as carbon dioxide.

CIBSE members in the UK and overseas are at the forefront of driving down carbon emissions from buildings. Indeed, climate change is one of five areas that CIBSE has identified as priorities. The others are whole-life building, systems integration, retrofit and refurbishment, and health and wellbeing (see panel 'CIBSE key priorities').

It is within this framework that *CIBSE Journal* and Mitsubishi Electric convened a roundtable to debate 'Heating, cooling and ventilating buildings – now and in the future'. A broad topic, perhaps, but one that allowed the panel (see boxout) to tackle issues that matter, including procurement, regulations and system integration.

If one key message was to emerge, it was this: teamwork and collaboration across the supply chain is vital for project success. Hopefully, BIM will prove to be a catalyst.

Change is gonna come

What technologies are we currently seeing in the marketplace, and what can we expect in the future? Horses for courses, perhaps, but some trends emerged among the panel. 'We see a lot of VRF [variable refrigerant flow] cooling


Alex Smith


Andy Ford (left), Susie Diamond and Mark Grayston


Wayne Buckley and Philip Todd


Mitesh Panikker

Tim Dwyer

systems rather than chillers,' said Thomas Doyle, principal mechanical engineer at Capita Symonds. 'Use of biomass has dropped off; we still see a lot of gas-fired heating, and combined heat and power (CHP) is great if you've got the right kind of load profile, because you are then offsetting your electricity consumption from the grid.

'The reduction in the cost of solar photovoltaic technology means you can use that to help you, too.'

Doyle also raised the issue of grid decarbonisation, which could signal a shift away from CHP to more electric systems.

'It is interesting to look at the true carbon effect of different systems,' said Tim Dwyer, technical editor at *CIBSE Journal* and University College London teaching fellow. 'The seasonal efficiencies of VRF are amazingly high, with CoPs [coefficients of performance] of 6, 6.5, even 7, which knock out gas as a fuel. If we do move to decarbonise the grid, we will start to see more heat pumps.'

Inkling partner Susie Diamond raised concerns over such a shift to heat-pump technology. 'Do we have enough peak capacity to cope, for example in winter, when temperatures are -4°C and heat pump efficiency is at its lowest? How does that square on a city-wide scale?'

Andy Ford, director of the Centre for Efficient and Renewable Energy in Buildings, London South Bank University (LSBU), felt that storage of heat will be important in this respect. 'Cold water heat networks could be used to deal with the efficiency of heat pumps at different times of year. For example, datacentres reject a lot of heat that could be used elsewhere. The question is, of course, how to do that in a way that is affordable.'

Legislation will be key in driving change. The HVAC market has been forced to innovate since the Montreal Protocol phased out CFC gases in the 1990s. The latest F-Gas Regulations look set to bring about another

> The HVAC market has had to innovate since the Montreal Protocol... the latest F-Gas Regulations look set to bring about another seismic shift

Who's who around the table

- Wayne Buckley, business development director, Temperature Control
- Sebastien Desmottes, product marketing manager, Mitsubishi Electric UK
- Susie Diamond, partner, Inkling
- Thomas Doyle, principal mechanical engineer, Capita Symonds
- Tim Dwyer, technical editor, *CIBSE Journal*, and UCL teaching fellow
- Andy Ford, director of the Centre for Efficient and Renewable Energy in Buildings, London South Bank University
- Mark Grayston, product manager, Mitsubishi Electric UK
- Mitesh Panikker, purchasing manager, Bourne Leisure
- Alex Smith, editor, *CIBSE Journal*
- Philip Todd, managing director, BSE3D

(from left) Thomas Doyle, Alex Smith and Sebastien Desmottes

Tim Dwyer stresses his point to the room

Ford (left) and Grayston listen in to Inkling's Diamond

seismic shift. 'Part L and the Eco Design Regulations have been driving up efficiencies, but the F-Gas Regs could have the biggest impact of all,' said Sebastien Desmottes, product marketing manager at Mitsubishi Electric UK. 'The amount of refrigerant gas used will have to go down. Hybrid VRF water-based systems are one solution.'

Mitsubishi Electric UK product manager, Mark Grayston, added: 'F-Gas is forcing us to make changes that people don't readily like to make, so we are trying to talk to them early. We developed the Hybrid VRF to maintain efficiency and comfort, while still complying with the requirements of F-Gas and the need to reduce refrigerants in occupied spaces.'

CIBSE's key priorities

- Whole-life building – whole-life costing, post-occupancy evaluation and understanding user behaviour
- Climate change: global challenges and opportunities of changing weather patterns
- Systems thinking and integration: taking a holistic approach to services, considering the integration of low carbon and renewable technologies, and how BIM can aid this
- Retrofit and refurbishment: how performance of existing housing can be improved to produce more efficient, healthy and comfortable buildings
- Health and wellbeing: how buildings can contribute to the quality of life, health and wellbeing of people, while keeping to energy efficiency targets

The educated client

As purchasing manager for Bourne Leisure, Mitesh Panikker decides which building services go into facilities for Butlins, Haven and Warner Leisure Hotels. What is he calling for from the supply chain? 'We are looking at total life-cycle costs of systems. We need to meet criteria such as comfort conditions, ease of control, maintenance requirements and energy efficiency, and we need stability of costs. For our market, the supply chain needs an understanding of the guest interface.'

For Panikker, it's not just the capital cost of kit that is important, but installed cost and methods of delivery. 'In cities, we want to minimise hot works for safe site practice, so some solutions will be more attractive than others,' he explains. 'If we are looking to refurbish existing stock, then the method of delivery is crucial. And if a new system is not easy to use for our guests, it might drive up energy consumption.'

Philip Todd, managing director at consultant BSE3D, has spent time on the tools, and thinks this has proved invaluable as a designer. 'I'm lucky – not many have had that opportunity. When you are designing a project, that experience helps you to consider installation and maintenance procedures, and the needs of those running the building.'

Bourne Leisure has built up a trusted supply chain, with long-term relationships. But not all projects are run this way. Outside of his day job, Todd is director at a Sussex-based school academy. 'Life-cycle costing does not come into the equation when we look to replace infrastructure such as a boiler – it's all about the capital costs.' He called for support from government when it comes to life-cycle costing for cash-strapped bodies.

'The industry has lost its way,' said Wayne Buckley, business development director at contractor Temperature Control. 'With design and build contracts, we see costs taken out at every stage. We get more successful outcomes when we can engage with the client early, offer open-book tendering and demonstrate a value, not cost, approach. Too much is pushing the risk down the supply chain.'

Ford agreed: 'At Fulcrum, we tried to share the risk on projects, but clients preferred to contain that risk with a contractor who would guarantee the result. It's frustrating, because you want to design something holistically.'

Diamond hoped that research into procurement routes – being conducted by Hoare Lea and expected to be unveiled at CIBSE's next Technical Symposium – will shed light on which pathways lead to successful project outcomes and could be

used to enlighten clients. 'The client brief has died over the past 10 years,' said Doyle. 'The in-house skills have been outsourced and the client's representatives may not fully understand the client's needs.'

Dwyer agreed. 'Clients don't know what they want. Engineering is too often about problem solving, rather than defining what the problem is. Properly informed engineers are the way forward. We have been dumbing down the industry too much – it's becoming something of a box-shifting industry.'

Ford recalled how Fulcrum had always set out to engage with architects early on – only then can you achieve holistic building design. 'We need to be there at the outset, when you can influence the orientation and so on, and have a massive impact on the services strategy. Those initial meetings can affect the performance of the building by as much as 50% by making buildings simpler – but you need to engage with architects in a language they understand, and be able to push at the beginning in a creative way.'

Desmottes said that, often, manufacturers are invited to the table too late. 'London's Zetter Hotel is an example, where we were able to move the client away from an air-source VRF solution to a water-based system, which has many benefits, including lower running costs and the fact that it takes up less roof space for the condensers. This meant extra rooms for the hotel – a huge asset.'

Joined-up thinking

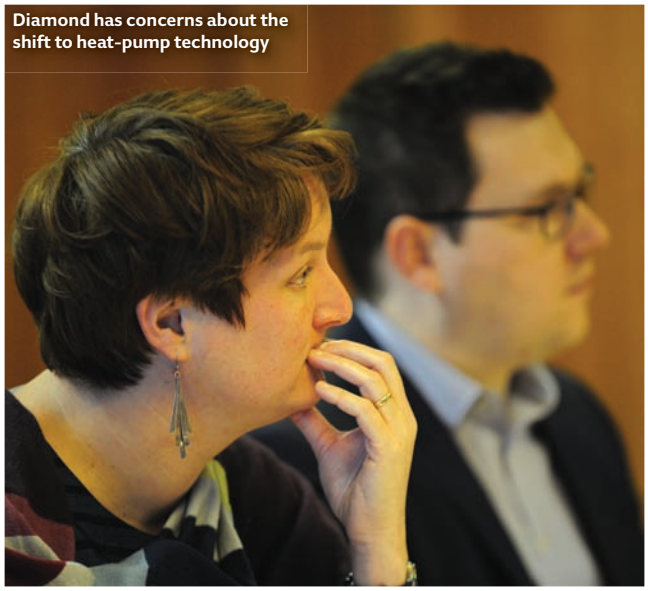
Ford outlined work by LSBU and other universities, alongside the Royal Academy of Engineering, on how we should teach architects and engineers in the future. Initiatives such as the multidisciplinary construction industry competition Teambuild will also engender collaborative working across the supply chain. Doyle felt that building information modelling (BIM) has the potential for closer integration between architects and building services consultants and the supply chain, but the benefits will only really be felt when Level 3 BIM is adopted. 'That's when it will get interesting.'

'Information really is power,' said Dwyer. 'Everything we've heard today revolves around more efficient information exchange. "Real" BIM is not about protocols or a glitzy front end, it's about sharing information – and that could be a major force in solving a lot of the issues we've heard about today.' **CJ**

WATCH NOW
Video interviews from the debate are at **www.cibsejournal.com**

Andy Ford makes an animated point to the roundtable

> Engineering is too often about problem solving, rather than defining what the problem is. Properly informed engineers are the way forward


Diamond has concerns about the shift to heat-pump technology


Desmottes wants manufacturers involved in projects earlier

CIBSE JOURNAL

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CAREERS SPECIAL

INTO THE SPOTLIGHT

Building services salary survey reveals big pay rises as skills shortage puts engineers centre stage

Driving change
Engineers' knowledge key to low carbon future

Bright lights
Young professionals take on London's latest landmarks

CIBSE JOURNAL

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Most wanted

This is a good time to be a building services engineer. The demand for their services is at fever pitch, and salaries are growing to reflect the fact demand is outstripping supply. The Hays Salary Guide reveals pay across all building services roles went up by 5% in the year to September 2015, and the salaries of intermediate M&E design engineers jumped by more than 7.5%. The shortage of good engineers in the marketplace means that candidates with the right skills could walk into a recruitment agency and have the pick of up to 20 roles.

Pay increases for existing senior engineers account for some of the rises as companies end salary freezes in light of growth in the construction sector since 2013. If firms are going to honour big design contracts, they must offer incentives to retain experienced engineers to lead these projects.

Of course, people don't come into the industry just because of good remuneration, they're also attracted by the opportunity to make a difference. Our feature on page 56 highlights how engineers' contribution will be essential if nations are to meet commitments spelled out at last year's climate change conference in Paris.

For young engineers, the work available in the sector is rich and varied. We focus on two up-and-coming engineers at ChapmanBDSP and Aecom, who had the privilege of working on two iconic London schemes – 20 Fenchurch Street and Southbank Place. These are not straightforward projects and the myriad skills of engineers will be called upon if we are to integrate sustainable new buildings into our crowded cities successfully.

Alex Smith, editor
asmith@cibsejournal.com

CONTENTS

Welcome from CIBSE

CIBSE wants to attract as many people into the building services industry as possible, and show them what an exciting and innovative profession it can be to work in.

By producing this guide, we hope to encourage students to consider building services engineering as a serious option for their future.

Building services engineers are at the forefront of developing environmentally friendly, high-performing buildings. The career is diverse and exciting, covering everything from initial building design to final operation, heating and ventilation systems, lighting design and building façades.

Building services engineers graduating today will be developing the buildings of the future and shaping the world we will live in.

As part of CIBSE's commitment to nurturing engineering talent, we give all full-time engineering students free CIBSE membership for the duration of their course; a small fee is payable for those studying on a part-time basis. As a member you can gain access to the huge resource which is our CIBSE Knowledge Portal, and the wealth of information it offers.

CIBSE's student initiative is designed to give engineering students access to CIBSE's vast vault of knowledge as well as first-class help and guidance throughout their studies, and onto the first steps of their professional engineering careers.

If you'd like more information about choosing a career in building services, and routes into the industry, please visit our website **www.cibse.org**

RISING TO THE CHALLENGE

Building services engineers are on the front line of the fight against climate change, and their expertise is crucial if the global carbon targets agreed in Paris are to be achieved. **Roxane McMeeken** looks at opportunities in the industry and profiles three engineers who are making a difference

The buildings and construction sector is responsible for almost one-third of global CO_2 emissions, according to the United Nations Framework Convention on Climate Change (UNFCCC). For this reason, the battle to achieve many of the aspirations set out at the UNFCCC's recent international climate change talks in Paris, COP21, will be fought out in the built-environment sector.

So if you want to tackle climate change, this is the industry to join. Philippe Honnorat, head of building services at global engineering giant WSP Parsons Brinckerhoff, says: 'At COP21, countries pulled together to form policies, but it will be engineers that put those policies into practice.'

Why building services?

The UNFCCC says buildings and construction are responsible for 30% of global carbon emissions, and this figure could hit 50% by 2050. So COP21, in December, looked at how the built environment can contribute to the conference's goal of limiting global temperature rise to 2°C. COP21 Buildings Day set out high-level aspirations, including: collaboration to improve the scale and efficiency of initiatives; increasing the efficiency of building systems and envelopes; mainstreaming low greenhouse gas emissions materials; and lowering the emissions of new and existing buildings.

Much of this boils down to improving building services systems, such as cooling, heating, lifts, lighting, plumbing and ventilation, that consume energy and water. So the people who design these are on the front line of the fight against climate change. What's more, building services is becoming ever-more innovative, as the built environment strives to reduce its impact, and the industry becomes increasingly digitised.

Ryan Rodrigues, an electrical engineering consultant at Hurleypalmerflatt, says: 'COP21 has helped to show the importance of what building services engineers do. Our role is to ensure buildings are as energy efficient as possible and every bit of difference each of us can make adds up.'

There are several areas in which building services engineers can have a powerful

OPPORTUNITIES

Building services cover a wide-ranging brief

- Management of the environmental performance of buildings throughout their life-cycles – the 'cradle to grave' approach
- Collaboration with world-leading clients, architects, interior designers, structural engineers and more
- Opportunities to work all over the world
- A role at the heart of construction projects – becoming even more integral because of the growing importance of energy efficiency
- A front-line place in the ongoing battle against global climate change
- Exciting projects, such as stadiums, skyscrapers, science laboratories, music venues, schools in developing countries, multinationals' headquarters, hospitals, art galleries and museums
- Working with cutting-edge and rapidly changing technology, including building information modelling
- Membership of CIBSE – a highly respected and agenda-setting body.

NILS VERSEMANN / SHUTTERSTOCK

Dwight Wilson

As digital engineering manager at Imtech, Dwight Wilson is developing processes and technologies that allow the company to integrate building information modelling (BIM) into everything it does. Wilson also sits on the Construction Industry Council's BIM 2050 group, which is driving take-up of the technology throughout the sector.

Wilson says: 'Through BIM, all the different companies working on a project exchange information because they all work on the shared digital model. This sweeps away potentially adversarial relationships between firms and gets everyone collaborating towards shared objectives.' This opens up new possibilities for innovation and energy efficiency: 'You can predict the energy used to construct, run and even demolish a building, so you start to achieve much more efficient buildings,' Wilson adds.

'Those of us working in BIM have a real sense of being in a community, because we are all trying to be progressive. By 2050, working digitally will be standard. It'll be like word processing is today. It's exciting to be involved in bringing about this change.'

impact, Rodrigues says. 'Some of the most effective fixes are installing LED [low energy] lighting.' Motion and light-level detectors can be added to ensure lights only come on when needed. In some cases, promoting a design that maximises natural light can slash the energy bill. Heating and cooling requirements can also be balanced and rationalised, starting with installing insulation to reduce the need for electrically powered temperature-control systems.

The next fundamental job is to study how and when the building will be used, and then to adjust the size of the electrical plant to match. 'Plant runs at its most efficient when 100% of it is being used,' says Rodrigues. 'If you have, say, an oversized air conditioning system running at 30%, that will be really inefficient.' As Honnorat puts it: 'You don't buy a Maserati if you mainly drive around London; you buy an electric car.'

Buildings can be designed to be super-sustainable but, if they are not used as intended, planned energy savings can be lost. Clare Wildfire, technical director at global engineering and development consultancy Mott MacDonald, says building services engineers have an increasing role to play in educating occupiers: 'Often, new buildings have complex systems and controls to minimise energy and water consumption, and – if end-users are unsure of how to work the technology – there is a tendency to just leave everything on, which can reverse what the systems are supposed to achieve.'

Building services engineers are also increasingly involved in more experimental solutions. Susie Diamond, partner at Inkling

> Building services is becoming ever-more innovative, as the built environment strives to reduce its impact and the industry becomes increasingly digitised

and vice-chair of the CIBSE Resilient Cities Group, says: 'One exciting new area is "green infrastructure", which uses plants to help regulate atmospheric conditions, reducing the need for artificial means. A "living wall" in an atrium could generate oxygen during the day, reducing the need for fresh air to be pushed in by electrically powered fans.'

The idea can also be applied at city level, where adding greenery is believed not only to benefit the local climate, but also to improve the health, wellbeing and perhaps even productivity of the inhabitants.

'While reducing energy is a critical goal, decarbonising the energy we do use is also vital,' says Susan Hone-Brookes, environmental leader, Laing O'Rourke. 'Adopting and understanding the correct deployment of renewable and emerging technologies – such as wind, solar, biomass and fuel-power cells – will be critical in delivering the cities of the future.'

It is down to building services engineers to make this happen at the level of individual buildings. They will also have to implement more experimental solutions, such as nuclear fusion. Different from fission, which is widely used, fusion is said to be so potent that it would allow the atoms in a single glass of water to power a city for a year.

Building services engineers are making significant strides in reducing the energy consumption of buildings. As a result, 'a new focus is growing around the energy that goes into the materials and products used in their construction', says Hone-Brookes. Building services engineers can make a difference in this area, she adds, 'by designing buildings that use responsibly sourced really low carbon materials, made using low carbon techniques, and which involve the minimum amount of time to transport to the site'.

Cities and resilience

Tackling climate change is not only a matter of reducing the resources we use, however. 'It's also about adapting to the change,' says Polly Turton, climate change and adaptation consultant at engineering consultant Arup. This means designing a built environment that can withstand warmer temperatures, stronger storms and rising sea levels.

Arup has exemplified this approach with its work on 100 City Road, a development in London comprising a 16-storey office building and five lower-rise, new-build and refurbished buildings, offering a mix of facilities. Arup analysed the future climate-change risks facing the development and identified 10 adaptation options. These included relaxing thermal comfort criteria. 'We need to redefine our definition of comfort in offices, as well as some of our cultural norms,' says Turton. So we can expect to dress less traditionally at work, to wear clothes to keep warmer or cooler, and to reduce our reliance on electrical systems for cooling and heating offices.

To be as resilient as possible to climate change, an approach is required that 'looks beyond individual buildings and addresses their wider context, including the infrastructure around them', says Turton. This is the focus of the CIBSE Resilient Cities Group, with which Turton is involved. Resilience, she says, is about ensuring that the urban environment promotes the health and wellbeing of residents, supports the economy and society, and is robust in terms of leadership, strategy, systems and services.

At city level, building services engineers can create economies of scale to preserve energy and water. Installing district energy systems will make the most effective use of energy across multiple types of buildings. For instance, waste heat from offices can be used to warm homes and swimming pools.

James Bourne

During his career in building services, James Bourne has worked on airport towers, gas turbines, a new army base in Iraq and security-sensitive telecoms tunnels beneath London. He has also run his own business and is now head of a multidisciplinary practice in Colchester, part of Atkins.

All this began with an apprenticeship as an electrical engineer, aged 17. Bourne says: 'I worked while doing day release at college and qualified as an electrician in my early 20s.' After working on site, he moved into project management before launching his own company. 'We provided electrical testing and design to local authorities and contractors.'

He was later recruited by Atkins as a building services team leader, and was sponsored to do first a degree, and then an MSc, in building services design, and to become chartered with CIBSE.

Today, Bourne's focus is on interdisciplinary collaboration. 'The sooner we are involved in a project, and the more closely we work with other disciplines – ideally on a shared BIM model – the bigger the impact we can have on a building's heating and ventilation requirements.'

Ryan Rodrigues

London-based electrical engineering consultant Ryan Rodrigues was crowned CIBSE Graduate of the Year in 2015. He achieved his Bachelor's degree before joining Hurleypalmerflatt (HPF), and then completing his Master's, which was part-sponsored by HPF.

Rodrigues' specialism is lighting. He says: 'There are so many mechanisms you can specify to improve the energy efficiency of buildings, but one of the most effective is in lighting, through LED [low energy] lighting, lighting control systems and renewable energy. LED lighting is probably the most powerful, because it tends to reduce the energy used for lighting by 30-40%.'

The challenge is to convince developers to pay the extra costs of LED lighting. If the developer will also be the occupier, this is an easy case to argue. 'They will recover their capital costs through cheaper running costs in around four years,' says Rodrigues. If the developer is selling the building, the case can still be made: 'They can market the buildings as having lower energy bills and contributing to companies' efforts to do their bit for the environment.'

TUPUNGATO / SHUTTERSTOCK

More than a half of the world's population are now urban dwellers, according to the United Nations, and 66% of us will live in a city by 2050. To position the built environment to address climate change will require building services engineers to work closely with other construction disciplines. This is because each discipline makes decisions that impact on the energy efficiency and climate risk of a building, says Wildfire. 'We need to work with clients and architects at the inception of projects to ensure the building's overall design reduces the requirements on its cooling and heating plant,' she says. 'This could mean ensuring that the building is orientated to minimise solar gain, or steering the design away from a fully glazed façade.'

This need for collaboration is being supported by growing digitisation within the industry. Building information modelling (BIM) allows all members of a project team to work on a shared 3D model of the project. This helps the various disciplines to 'see' each other's work, opening up new potential for efficient and complementary designs and construction processes, as well as vastly improved clash detection.

As the industry moves to implement the aspirations of COP21, however, it will face challenges. 'It will be difficult for a single stakeholder to implement the changes needed, so we will need a coordinated effort by city mayors, the private sector, academia and civil society,' says Turton. The key, she adds, will be identifying 'win-win solutions', such as a more comfortable built environment that not only saves energy, but also promotes health and wellbeing.

A key battle for building services engineers will be persuading developers to invest in greener buildings, even when they are not going to be the occupier. Wildfire says: 'You have to translate the need for resilience and sustainability into commercial terms. Our role is to make arguments, such as buildings that use less power will reduce the demand on the power network – which, in turn, reduces the likelihood of blackouts and the risk to business continuity.'

As building services engineers begin turning the aspirations of COP21 into reality, the road will not be easy. However, the discipline promises to provide meaningful and interesting career opportunities.

> At city level, adding greenery is believed not only to benefit the local climate, but also to improve the health and wellbeing of the inhabitants

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>
> *– Kayley Lockhead, ACIBSE IEng, UK*

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BANKABLE STARS

Building services engineers are currently the most sought-after professionals in construction, with the latest Hays Salary Guide revealing inflation-busting wage rises of more than 7%. Roxane McMeeken asks whether firms can afford the sharp jump in pay

'We are finding it hard to recruit the right skills. When we do find someone we want to hire, they often come back to us saying they've had a counter-offer. We try to beat it – depending on the case – but we won't be pressurised every time,' says Jay Amin, head of human resources at Hurleypalmerflatt.

It's a statement that seems to reflect the fraught recruitment experiences of most building services engineering firms.

The competition for building services engineers has been at fever pitch for 18 months. Salary rises for this group have far outstripped the average rise for all professionals, and a candidate walking into a recruitment agency with the right skills could find 20 roles to apply for.

Demand shows little sign of cooling off in the year ahead, but can salaries keep increasing at the same rate – especially while the fees earned by companies in the sector continue to remain little changed? And aside from money, what else can employers do to recruit and retain staff in this particularly bruising battle for talent?

20 jobs per candidate

According to the latest salary guide and survey of employers and candidates, compiled by recruitment agent Hays exclusively for CIBSE, the average pay increase across all building services roles during the 12 months to September 2015 was 5%. This is higher than the growth of 2.3% seen over the same period in the UK average salary across all professions. Building

Consultant: director

	Typical 2016	Min 2016	Max 2016
London	£85,000	£80,000	£100,000
South West	£55,000	£52,000	£65,000
South East	£67,000	£62,000	£72,000
Wales	£53,000	£52,000	£57,000
East of England	£61,000	£50,000	£70,000
West Midlands	£60,000	£55,000	£65,000
East Midlands	£57,500	£55,000	£65,000
North West	£60,000	£50,000	£65,000
Yorkshire & the Humber	£50,000	£42,000	£54,000
Northern Ireland	£60,000	£45,000	£70,000
North East	£50,000	£42,000	£54,000
Scotland	£55,000	£50,000	£60,000
National average	**£59,458**	**£52,917**	**£66,417**
% increase year on year	**4.62%**		

SHUTTERSTOCK / DENIS MAKARENKO

services also beat the average pay rise seen in the wider construction and property sector of 3.6%.

For some building services roles, Hays identified even stronger uplifts in salaries. Intermediate design engineers (mechanical and electrical) saw the highest growth within consulting roles, with a national average salary increase of 7.57%. On the contracting side, senior contract managers enjoyed the highest increases, with a national average rise of 8.34%.

While Hays records salaries for new appointments, its survey of employers revealed that there have been widespread pay rises for existing staff members, with 69% of employers enjoying increased salaries in the past 12 months. Those interviewed for this feature suggested that the degree of pay rises for existing staff members more or less matches those of new recruits.

ChapmanBDSP, for example, confirmed it had increased salaries in 2014 by an average of 6%, excluding promotions. The firms we spoke to also agreed that senior engineers were most sought-after, as well as all those with experience of building information modelling (BIM) – the former as a result of a long-term skills gap, and the latter down to a lack of experts in relatively new – but increasingly in-demand – 3D-modelling technology.

The demand for talent is, in large part, being spurred by the increase in activity. Recently released construction output figures from Markit/CIPS showed that, in October, the construction sector saw its fastest increase in new work for 12 months.

While output slowed somewhat in November, the survey recorded a return to growth in December, with commercial construction leading the bounce and hitting a 14-month high. Richard Gelder, UK director, property and built environment, at Hays, says: 'The recovery phase from late 2013 to early 2015 meant firms experienced a sudden rise in workload, so employers had to start building teams.'

Consultant: associate

	Typical 2016	Min 2016	Max 2016
London	£68,000	£60,000	£75,000
South West	£51,000	£48,000	£60,000
South East	£56,000	£52,000	£60,000
Wales	£50,500	£40,000	£52,000
East of England	£51,000	£50,000	£65,000
West Midlands	£50,000	£48,000	£55,000
East Midlands	£50,500	£50,000	£55,000
North West	£50,000	£45,000	£55,000
Yorkshire & the Humber	£45,000	£42,000	£48,000
Northern Ireland	£50,000	£45,000	£55,000
North East	£42,000	£38,000	£45,000
Scotland	£50,000	£50,000	£55,000
National average	**£51,167**	**£47,333**	**£56,667**
% increase year on year	**5.50%**		

Consultant: senior design engineer (M&E)

	Typical 2016	Min 2016	Max 2016
London	£55,000	£50,000	£65,000
South West	£45,000	£40,000	£50,000
South East	£51,000	£45,000	£55,000
Wales	£43,500	£38,000	£45,000
East of England	£45,000	£34,000	£55,000
West Midlands	£42,000	£38,000	£45,000
East Midlands	£43,000	£40,000	£50,000
North West	£43,000	£38,000	£48,000
Yorkshire & the Humber	£40,000	£38,000	£45,000
Northern Ireland	£38,000	£35,000	£44,000
North East	£43,000	£40,000	£45,000
Scotland	£44,000	£40,000	£45,000
National average	**£44,375**	**£39,667**	**£49,333**
% increase year on year	**4.62%**		

Consultant: Revit/BIM technician

	Typical 2016	Min 2016	Max 2016
London	£41,000	£40,000	£55,000
South West	£35,000	£30,000	£40,000
South East	£38,000	£35,000	£42,000
Wales	£34,000	£30,000	£35,000
East of England	£30,000	£28,000	£37,000
West Midlands	£29,000	£26,000	£34,000
East Midlands	£29,000	£25,000	£35,000
North West	£34,000	£28,000	£36,000
Yorkshire & the Humber	£32,000	£28,000	£35,000
Northern Ireland	£24,000	£22,000	£28,000
North East	£32,000	£28,000	£35,000
Scotland	£25,000	£23,000	£30,000
National average	**£31,917**	**£28,583**	**£36,833**
% increase year on year	**5.80%**		

Consultant: intermediate design engineer (M&E)

	Typical 2016	Min 2016	Max 2016
London	£38,000	£32,000	£40,000
South West	£35,000	£30,000	£40,000
South East	£32,000	£30,000	£35,000
Wales	£34,000	£28,000	£35,000
East of England	£35,000	£30,000	£40,000
West Midlands	£28,000	£25,000	£32,000
East Midlands	£31,000	£30,000	£38,000
North West	£32,000	£28,000	£35,000
Yorkshire & the Humber	£25,000	£22,000	£28,000
Northern Ireland	£25,000	£23,000	£28,000
North East	£29,500	£28,000	£32,000
Scotland	£32,000	£30,000	£38,000
National average	**£31,375**	**£28,000**	**£35,083**
% increase year on year	**7.57%**		

Consultant: junior design engineer (M&E)

	Typical 2016	Min 2016	Max 2016
London	£28,000	£24,000	£30,000
South West	£25,000	£24,000	£28,000
South East	£28,000	£26,000	£32,000
Wales	£23,500	£22,000	£25,000
East of England	£23,000	£17,500	£25,000
West Midlands	£21,000	£18,000	£22,000
East Midlands	£24,000	£20,000	£25,000
North West	£23,000	£21,000	£25,000
Yorkshire & the Humber	£20,000	£18,000	£24,000
Northern Ireland	£23,000	£20,000	£24,000
North East	£21,000	£18,000	£24,000
Scotland	£25,000	£22,000	£28,000
National average	**£23,708**	**£20,875**	**£26,000**
% increase year on year	**3.64%**		

Contractor: senior contracts manager

	Typical 2016	Min 2016	Max 2016
London	£60,000	£50,000	£70,000
South West	£45,000	£45,000	£50,000
South East	£55,000	£50,000	£60,000
Wales	£46,000	£40,000	£50,000
East of England	£49,000	£45,000	£58,000
West Midlands	£48,500	£40,000	£55,000
East Midlands	£44,000	£43,000	£55,000
North West	£43,000	£40,000	£50,000
Yorkshire & the Humber	£37,000	£34,000	£43,500
Northern Ireland	£42,000	£38,000	£45,000
North East	£38,500	£30,000	£45,000
Scotland	£44,000	£38,000	£47,000
National average	**£46,000**	**£41,083**	**£52,375**
% increase year on year	**8.34%**		

But building teams has not been easy. Gelder says that, in building services, 'there are probably 10 to 15 jobs per candidate on average. It varies; mechanical design engineers might have 10 jobs, but a Revit [BIM] specialist could have 20'.

This dramatic supply and demand scenario is not down to rising workloads alone. Off the record, some employers told *CIBSE Journal* that they believe recruitment agents have been 'stoking' wage rises. However, Gelder denies this. 'We are not the ones paying the salaries,' he says.

He attributes the situation, in part, to a chronic lack of skills. 'Even during the recession there was a shortage of skills in building services. The market has never really had an excess. Yes, people were laid off in the recession, but I believe more people retired and fewer entered the industry.'

In addition, the recent salary rises have also 'corrected' pay levels to counter the wage freezes and salary cuts seen during the seven-year downturn. Jerry Lehane, ChapmanBDSP's managing director, says: 'We had a few years without pay rises, so we increased salaries partly to adjust for that.'

Yet, over the past 18 months, building services firms have found that even their newly pumped-up salaries are insufficient to lure candidates. Many we interviewed report that it has become routine for a candidate about to sign a contract to reveal they have been made a counter-offer by either their existing employer or a rival recruiter. Lehane says that in this scenario, there are two choices: 'You can either try to compete with the silly salaries being offered or walk away. But those firms that choose to compete know that, as consultants, our largest overhead is salaries and we all earn roughly the same sorts of fees – so people can't be employing all their staff on these inflated salaries.'

BIKERIDERLONDON / SHUTTERSTOCK

Strategic hires

Indeed, with fees showing little sign of rising anywhere near as dramatically as salaries, the rates at which pay has been increasing looks unlikely to continue this year. Gelder says: 'In 2016, we will see the rate of growth slow down. I expect building services salaries to rise on average nationally by 2.5% to 3%.'

Another factor behind this looming change in the recruitment market, Gelder says, is that 'those who really wanted to move have moved and people have grown the bulk of their teams. Most employers now need just one or two people, so recruitment in 2016 will be about strategic hires or replacing someone'.

But it will be no easier to fill these vacancies. 'Employers are resigned to it taking six months to fill a role,' Gelder says. This headache is set to affect the majority of employers too. Hays's survey of firms found that 71% expect activity levels to rise over the next 12 months and 82% plan to recruit.

If major salary rises are not in the pipeline, how else will firms attract candidates and retain their best people? Philippe Honnorat, head of building services at global WSP Parsons Brinckerhoff, believes the emphasis will now shift to bonuses – especially as

Consultant: CAD technician

	Typical 2016	Min 2016	Max 2016
London	£34,000	£30,000	£38,000
South West	£28,000	£25,000	£30,000
South East	£31,000	£28,000	£34,000
Wales	£27,500	£23,000	£28,000
East of England	£28,000	£25,000	£37,000
West Midlands	£26,000	£23,000	£30,000
East Midlands	£27,500	£25,000	£30,000
North West	£26,000	£23,000	£30,000
Yorkshire & the Humber	£25,000	£22,000	£28,000
Northern Ireland	£20,000	£18,000	£23,000
North East	£24,000	£21,000	£25,000
Scotland	£21,000	£20,000	£25,000
National average	**£26,500**	**£23,583**	**£29,833**
% increase year on year	**6.71%**		

Contractor: director

	Typical 2016	Min 2016	Max 2016
London	£85,000	£70,000	£100,000
South West	£55,000	£50,000	£58,000
South East	£67,000	£60,000	£75,000
Wales	£53,500	£52,000	£60,000
East of England	£55,000	£50,000	£70,000
West Midlands	£58,000	£55,000	£70,000
East Midlands	£52,000	£47,000	£57,000
North West	£55,000	£50,000	£60,000
Yorkshire & the Humber	£56,000	£55,000	£60,000
Northern Ireland	£60,000	£50,000	£75,000
North East	£52,000	£48,000	£60,000
Scotland	£50,000	£45,000	£55,000
National average	**£58,208**	**£52,667**	**£66,667**
% increase year on year	**5.00%**		

Contractor: contract quantity surveyor

	Typical 2016	Min 2016	Max 2016
London	£55,000	£45,000	£75,000
South West	£40,000	£38,000	£45,000
South East	£53,000	£50,000	£65,000
Wales	£38,500	£34,000	£44,000
East of England	£37,500	£30,000	£40,000
West Midlands	£38,000	£33,000	£40,000
East Midlands	£40,000	£40,000	£45,000
North West	£38,000	£38,000	£42,000
Yorkshire & the Humber	£35,000	£30,000	£40,000
Northern Ireland	£35,000	£31,000	£38,000
North East	£36,500	£32,000	£42,000
Scotland	£40,000	£35,000	£42,000
National average	**£40,542**	**£36,333**	**£46,500**
% increase year on year	**5.30%**		

Survey highlights

More than two thirds (69%) of employers increased salaries in the 12 months to September 2015, and nearly the same number (68%) expect salaries to increase again during the following 12 months.

Despite salary increases, 59% of employees say they are unhappy with their salary. Just 36% asked for a pay rise in the past year and, of those, only 45% were successful in their request.

Nearly two-thirds (64%) of employees anticipate moving jobs in the next 12 months.

Some 58% of employees feel there is scope for career progression within their current organisation.

The benefits rated most important to building services professionals when considering a new role were:

- **More than 25 days annual leave and flexible working (both rated a priority by 44% of employees)**
- **An above-statutory pension contribution (36%)**
- **A company car or car allowance (28%).**

Contractor: project manager

	Typical 2016	Min 2016	Max 2016
London	£60,000	£50,000	£65,000
South West	£45,000	£40,000	£45,000
South East	£55,000	£50,000	£60,000
Wales	£40,000	£37,000	£42,000
East of England	£45,000	£38,000	£55,000
West Midlands	£42,000	£35,000	£50,000
East Midlands	£43,000	£40,000	£46,000
North West	£42,500	£40,000	£50,000
Yorkshire & the Humber	£43,000	£40,000	£57,000
Northern Ireland	£35,000	£33,000	£36,000
North East	£42,500	£40,000	£50,000
Scotland	£40,000	£38,000	£47,000
National average	**£44,417**	**£40,083**	**£50,250**
% increase year on year	**4.92%**		

Contractor: CAD technician

	Typical 2016	Min 2016	Max 2016
London	£36,000	£30,000	£45,000
South West	£28,000	£25,000	£30,000
South East	£31,000	£28,000	£35,000
Wales	£26,500	£24,000	£34,000
East of England	£24,000	£22,000	£26,000
West Midlands	£26,000	£22,000	£32,000
East Midlands	£27,500	£25,000	£30,000
North West	£26,000	£23,000	£30,000
Yorkshire & the Humber	£24,000	£21,000	£26,500
Northern Ireland	£25,000	£22,000	£26,500
North East	£26,500	£22,000	£25,000
Scotland	£21,000	£18,000	£22,000
National average	**£26,792**	**£23,500**	**£30,167**
% increase year on year	**4.89%**		

Contractor: project engineer

	Typical 2016	Min 2016	Max 2016
London	£44,000	£35,000	£50,000
South West	£35,000	£35,000	£45,000
South East	£36,000	£32,000	£40,000
Wales	£34,000	£28,000	£35,000
East of England	£35,000	£30,000	£40,000
West Midlands	£36,000	£30,000	£40,000
East Midlands	£34,500	£30,000	£38,000
North West	£35,000	£32,000	£38,000
Yorkshire & the Humber	£32,000	£30,000	£40,000
Northern Ireland	£30,000	£28,000	£33,000
North East	£31,000	£27,500	£35,750
Scotland	£36,000	£29,000	£37,000
National average	**£34,875**	**£30,542**	**£39,313**
% increase year on year	**7.00%**		

Contractor: estimator

	Typical 2016	Min 2016	Max 2016
London	£50,000	£45,000	£60,000
South West	£38,000	£35,000	£45,000
South East	£49,000	£45,000	£55,000
Wales	£35,000	£30,000	£37,000
East of England	£40,000	£32,000	£45,000
West Midlands	£38,000	£28,000	£40,000
East Midlands	£40,000	£35,000	£45,000
North West	£36,000	£35,000	£42,000
Yorkshire & the Humber	£33,000	£25,000	£35,000
Northern Ireland	£31,000	£30,000	£36,000
North East	£35,000	£29,000	£36,750
Scotland	£35,000	£30,000	£38,000
National average	**£38,333**	**£33,250**	**£42,896**
% increase year on year	**5.62%**		

> The skills shortage will remain a challenge for all building services companies into 2016 and beyond

relatively low fees drive companies to produce more with less resource. 'Those that deliver projects efficiently will be rewarded with bonuses, within the constraints of fees that have not budged all that much.'

Benefits are unlikely to be a major differentiator for a candidate choosing between firms. Gelder says: 'In 2014 we saw a dash to add benefits like health cover and cycle-to-work schemes. Now they are in place widely and any employer not offering decent benefits will look a bit lacking.' Hurleypalmerflatt, for example, added income protection in 2014.

With benefits covered, Gelder says building services employers should now 'work on their vision', by which he means developing an image of the company to project to candidates. 'The vision is developed from asking what is special about working for the company, whether the office is attractive and what the culture is like.'

He advises firms to cultivate their image, not just in job descriptions and what is said in interviews, but also through the 'physical signs you get from an interview – whether the boss came to meet you during the interview, who you were greeted by in reception, and how long you had to wait'.

Honnorat believes that this is a key recruitment-and-retention tool for WSP. 'We have an entrepreneurial approach. People are given a lot of freedom to pursue clients and develop services, as long as it fits our overall strategy, and our people like that. This has resulted in us recruiting candidates from firms they wanted to leave because of a 'command and control' type culture.'

Growing your own talent is a tried and tested method. Gelder believes building services firms are – admirably – 'busting a gut' to bring in graduates and apprentices, and all those we interviewed had well-established graduate schemes, with many introducing apprenticeships too. Hoare Lea launched such a scheme in 2012.

Paul Tymkow, the firm's director of learning and knowledge, says: 'We felt we needed more breadth in our intake, and to catch people earlier – there is a lot of competition for graduates.'

But Gelder warns that it will take time for these programmes to have an impact. 'This is oil tanker stuff.' It will be three to five years before the current intake moves into roles with a considerable degree of responsibility.

And how to retain this new blood? Hurleypalmerflatt's Gifted and Talented scheme is a succession-planning strategy that aims to both retain and push its best people. Amin says: 'We have chosen individuals at different levels of seniority, who are keen to be promoted, and we are working with them to help them get there. They are being measured against key performance indicators and reviewed every six months, as well as receiving training in skills such as presentation, contract negotiations and people and commercial management.'

There are other tactics for building and maintaining teams, of course, such as loyalty bonuses, and the smartest firms are likely to use a range of them. Even so, the skills shortage will remain a challenge for all building services companies into 2016 and beyond. As a result, success will likely depend – as Honnorat suggests – on how efficient companies can be with limited staff. In which case, the move towards greater use of BIM, including the technology's ability to take on the more mundane tasks performed by building services engineers, cannot go fast enough.

Cardiff University

Address: Cardiff School of Engineering, Queen's Buildings, The Parade, Cardiff, CF24 3AA
Website: www.cardiff.ac.uk/engin
Telephone: 029 2087 0050
Contact: Sunny Deng, admissions office
Email: engineering-pg@cardiff.ac.uk
Courses offered: MSc in Manufacturing Engineering, Innovation and Management; MSc Structural Engineering; MSc Civil Engineering; MSc Civil and Geo-environmental Engineering; MSc Civil and Water Engineering; MSc Sustainable Energy and Environment; MSc Professional Engineering (Distance Learning); MSc Advanced Mechanical Engineering; MSc Electrical Energy Systems; MSc Wireless and Microwave Engineering.

Leeds College of Building

Address: North Street, Leeds, LS2 7QT
Website: www.lcb.ac.uk
Telephone: 01132 226003
Contact: Higher Education Department
Email: info@lcb.ac.uk
Courses offered: As specialists in construction education and training, the college offers complete progression routes, from entry level to senior management and design, including: Level 3 diplomas, subsidiary diplomas and advanced apprenticeships; Level 4 HNC; and Level 5 HND and higher apprenticeships. Full-time, part-time, day release and distance learning study options available.

Heriot-Watt University

Address: School of Energy, Geoscience, Infrastructure and Society, Edinburgh Campus, Edinburgh, EH14 4AS
Website: www.hw.ac.uk/egis
Telephone: 0131 451 8363
Contact: EGIS School Office
Email: egis-enquiries@hw.ac.uk;
Distance Learning: All MSc courses are available via independent distance learning (IDL). Contact: EGIS-idl-enquiries@hw.ac.uk
Courses offered: CIBSE and EI accredited: BEng (Hons)/MEng Architectural Engineering; BEng (Hons)/MEng Architectural Engineering with International Studies; MSc Architectural Engineering; MSc Sustainable Building Design.
RICS and CIOB accredited: MSc Building Conservation (Technology & Management); MSc Construction Project Management.
EI accredited: MSc Carbon & Energy Management.
RICS accredited: MSc Quantity Surveying; MSc Real Estate & Planning, MSc Real Estate Management & Development; MSc Real Estate Investment & Finance; and MSc Sustainable Urban Management.

Loughborough University

Address: School of Civil and Building Engineering, Loughborough University, Loughborough, Leicestershire LE11 3TU
Website: www.lboro.ac.uk/civil
Telephone: 01509 228529
Contact: Pam Allen
Email: p.j.allen@lboro.ac.uk
Courses offered: CIBSE and EI accredited: MSc Low Carbon Building Design and Modelling; MSc Low Energy Building Services Engineering.
JBM accredited for 'further learning' and CIWEM accredited: Water and Environmental Management; Water and Waste Engineering; and Infrastructure in Emergencies.
JBM, RICS and CIOB accredited: MSc Construction Management; and MSc Construction Project Management.
Other Master's course: MRes Energy Demand Studies.

Northumbria University, Newcastle

Address: Sutherland Building. Newcastle upon Tyne, NE1 8ST
Website: www.northumbria.ac.uk
Contact: Admissions Team
Email: course.enquiries@northumbria.ac.uk
Telephone: 0191 349 5600
Courses offered: Full-time – BEng (Hons) Mechanical and Architectural Engineering; MEng (Hons) Mechanical and Architectural Engineering. Part-time – BEng (Hons) Building Services Engineering; MEng (Hons) Building Services Engineering.

University of Ulster

Address: Shore Road, Newtownabbey, Northern Ireland, BT37 0QB
Website: study.ulster.ac.uk
Telephone: 028 9036 6521
Contact: Faculty Office
Email: adbe@ulster.ac.uk
Courses offered: CIBSE accredited: BEng (Hons) Architectural Engineering (full-and part-time); MSc Fire Safety Engineering (full and part-time); MSc Renewable Energy and Energy Management (part-time and distance learning).

WALKING TALL

A career in building services engineering offers an opportunity to work on buildings designed by some of the biggest names in architecture. **Roxane McMeeken** speaks to two young engineers who have each worked on prominent London schemes

Alex Beeslee, intermediate mechanical engineer, ChapmanBDSP 20 Fenchurch Street (aka 'the Walkie-Talkie')

A bold new skyscraper on London's skyline was one of the first projects Alex Beeslee worked on after graduating. Nicknamed 'the Walkie-Talkie' because of its distinctive shape, the striking 20 Fenchurch Street office building, in the City, was designed by world-renowned architect Rafael Viñoly – not a bad project for your CV just three years after finishing university.

'It's a great buzz to have been involved in working on such a landmark. If you're coming into London by train, you can point it out and say: "I worked on that"', says Beeslee.

Beeslee is an intermediate mechanical engineer for ChapmanBDSP, which advised on 20 Fenchurch Street's base build, and provided building services engineering to two of the companies that moved into the development. Having graduated from the University of Leicester with a BA in mechanical engineering, he entered ChapmanBDSP's graduate scheme, and has been in the firm's mechanical engineering team ever since.

On 20 Fenchurch Street, Beeslee joined the project during the latter stages – known as fit-out – which involves designing and constructing the interior of the building according to the requirements of its future occupiers. Part of this involves installing building services, the systems – such as lighting, lifts, heating, cooling, plumbing and ventilation – that make the building work.

Beeslee's role was to work with senior engineers in designing systems to provide comfort cooling and fresh air to a number of floors. He says: 'It was a real eye-opener to get exposed to such a major project so early on in my career. It was a fast-moving project, involving top companies, and I learned a lot, very quickly.

'Because the project was so high-profile, everything was being done to the highest standards, so it was a great grounding in how things should be done.'

The most exciting aspect of the project, for Beeslee, was that all the construction disciplines, from different companies, had to work together. 'It was amazing to see how the design progressed through input from all the disciplines, highlighting any problems that needed sorting out and adapting one element to accommodate another.'

The key challenge for ChapmanBDSP's work on the higher floors was the fact that the building narrows near the top. 'The building's shape means that, the higher you go, the more beams you have getting in the way of building services. Of course, beams have to take priority – they are, after all, holding up the building! So we had to work around them.'

This required an even greater degree of collaboration with other disciplines, such as architects, structural engineers and specialist contractors. 'I found that the key was being as open as possible, so – if there was a problem with an element – you would call the person you were designing it with and address it together,' says Beeslee.

> I found the key was being as open as possible, so – if there was a problem – you would address it together

Such collaborative working is increasingly being facilitated in the construction industry by the use of cutting-edge, shared 3D models of projects. The approach, known as building information modelling (BIM), allows people in different locations to work together on a shared digital design.

Beeslee, who has recently received training in BIM, says: 'It makes the process of coordinating the design flow so much smoother. The digitisation of the industry is very exciting'

Beeslee chose building services during his degree course after spending a month in the university's environmental buildings services department. He says: 'The impact that building services engineers can have on

DAVID BURROWS / SHUTTERSTOCK

Beeslee worked on the 'Walkie-Talkie' after graduating

sustainability is what drew me to the discipline. So far, I am pleased with my choice, because pretty much every building designed now features carbon-reduction technology.'

Since the Walkie-Talkie, Beeslee has continued to be involved with high-profile projects at ChapmanBDSP and is currently working for Great Portland Estates.

'Building services has been an incredibly fulfilling career so far,' he says. 'Completing projects is very satisfying and you are challenged every day because each project is different.'

Ella Pope, mechanical engineer, Aecom, Southbank Place

Ella Pope is working on an exciting project on London's Southbank to transform the Shell Centre Tower and its surrounding area into a new development, comprising eight buildings, called Southbank Place. The existing tower is being retained as the centrepiece of the scheme, featuring homes, offices and shops, as well as landscaped open space – all on the doorstep of the London Eye.

Pope says: 'It's brilliant to be on a large scheme in the heart of London. I am part of a large team and it's really rewarding for us all to see the buildings coming together.'

Pope is a mechanical engineer at Aecom, where she has just completed the graduate scheme. She joined the firm after completing a BEng in architectural environmental engineering at the University of Nottingham, a building services-orientated degree course.

Aecom's role is to design the building services infrastructure serving the whole site – located in the giant basement of the former Shell Centre – as well as for two of the buildings 10 and 17 storeys high. Pope has carried out mechanical engineering on both aspects of Aecom's role, and led the coordination of electrical and mechanical services in the basement with the rest of the building and with other services, such as public health.

Pope says: 'The key challenge is the sheer size of the infrastructure needed to serve the eight buildings, and fitting it all into a basement that previously served only the Shell Centre. It requires intense coordination between all the services being installed.' For example, the site requires 12MW of heating and 15MW of cooling. This compares with the 5kW needed to heat the average home.

Aecom's job is further complicated by the fact that each of the eight buildings is being designed by a different architectural practice. As a result, Pope says: 'Another huge amount of coordination between different firms is needed.'

Thankfully, the entire Southbank Place is being designed in BIM. This makes it one of the largest commercial projects in the UK to be designed and constructed digitally.

Pope says that working in BIM is not necessarily easy: 'It presents you with challenges because you design in a greater level of detail, but it makes your life easier because you can see more of what's going on in the building.'

The benefits of BIM are undeniable, Pope says. 'General coordination is better and you can see opportunities in 3D that you simply wouldn't in 2D.

'An example would be a really tight corridor. The 3D model shows you that the corridor is next to a plantroom with spare capacity, so you can move some of what's in the corridor into the plantroom.'

Pope says she loves the unexpected obstacles that the project can throw up. 'It's challenging every day because construction is happening on site right now, so if a problem crops up you have to think of a solution on the spot.'

She adds: 'Knowing that you are part of a process where a building will get built is really satisfying. I think building services is one of the most rewarding areas of engineering.'

Pope is helping to transform the area around the Shell Centre Tower on London's Southbank

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Ventilation and gas safety in the commercial kitchen

This module explores the need for ventilation and other key safety issues associated with gas-fired cooking in commercial kitchens

Cooking food in a commercial kitchen can potentially lead to a highly contaminated environment. The correct design of the ventilation and cooking equipment is, therefore, important to protect the health of the kitchen staff – as well as those in adjacent spaces – by ensuring the removal of the by-products of cooking, and addressing the hazards from burning gas. This CPD will focus on the need for appropriate ventilation for the health and comfort of kitchen staff, and on the safety issues associated with gas-fired cooking – plus, in the process, showing that the multiple standards covering these areas are not always completely in step.

A commercial kitchen is described in BS 6173[1] as any kitchen other than a domestic or guesthouse kitchen. However, much of the reported research is focused on domestic applications. This article will draw on a broad set of references, many of which consider health effects of airborne contaminants that are hazardous to humans – whether in a commercial or domestic setting.

The case for adequate ventilation when cooking food

Research undertaken by Dennekamp et al[2] concluded that 'cooking in a poorly ventilated kitchen may give rise to potentially toxic concentrations of numbers of particles. Very high concentrations of oxides of nitrogen may also be generated by gas cooking and, with no extraction and poor ventilation, may reach concentrations at which adverse health effects may be expected'.

Cooking appliances and the process of cooking itself can produce numerous pollutants.[3] For instance, frying will produce acrolein (toxic and a strong irritant for the skin, eyes, and nose) and polycyclic aromatic hydrocarbons (numerous associations with adverse health), and large amounts of ultrafine (<0.1 μm) particles. Gas burners will generate nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM), and formaldehyde (with its well documented health impacts).

The UK's Committee on the Medical Effects of Air Pollutants (COMEAP) has recently reviewed[4] the current body of research on the effect of NO_2 on health. It concluded that, although in many cases the adverse health effects may be associated with other contaminants that coexist with NO_2 in the

SNVV / SHUTTERSTOCK

environment (such as small particles PM_{10} and $PM_{2.5}$), NO_2 is responsible for detrimental health impacts. Both short-term and extended exposure were determined to impact on health, and the review cited a report by Faustini[5], which concluded that the magnitude of the effect of long-term NO_2 exposure on mortality is at least as important as that of $PM_{2.5}$.

The use of gas for cooking requires an appropriate supply of air for complete combustion – otherwise high levels of CO will be produced. An extensive review[6] of the scientific knowledge on CO, including the effect on human health, was undertaken by Penney et al for the World Health Organisation (WHO) in 2010. The report is thought-provoking, not only in terms of the multitude of cited research that relates health problems to both acute (short-term) and chronic (repeated, continuous) CO exposure, but also in the variety of potential disorders that can result from this. For example, at relatively low CO levels there is evidence of increased incidences of low birth weight, congenital defects, infant and adult mortality, cardiovascular hospital admissions, congestive heart failure, stroke, asthma, tuberculosis and pneumonia. It is widely understood that CO poisoning can be fatal, though it is probably less well understood that long-term low exposure is likely to lead to health issues. It appears that long-term exposures to lower levels of CO may have wider-ranging implications for human health than do acute CO exposures. The research has linked it to physical symptoms, sensory-motor changes, cognitive memory deficits, emotional-psychiatric alterations, cardiac events and low birth weight. And the identified cases of CO poisoning may well be significantly under-reported since it concludes that 'it is established that many cases of carbon monoxide toxicity are misdiagnosed because the symptoms mimic other health problems'.

The UK Health and Safety Executive (HSE) document EH40[7], updated in 2011, limits the eight-hour weighted average for workplace exposure to 30ppm, and 200ppm for 15 minutes. The WHO recommendation, updated in 2009, sets the limit[8] at $9mg \cdot m^{-3}$ (7ppm) over eight hours, and $100mg \cdot m^{-3}$ (81ppm) for 15 minutes.

Ensuring appropriate ventilation

In a commercial kitchen, air change is normally supplied by a mechanical ventilation system. This is most often by means of an extract canopy, situated above the appliances to remove the by-products of the cooking process. Sufficient outdoor air must be provided through supply fans, or by natural ventilation, in order to replace the extracted air. The Institution of Gas Engineers and Managers (IGEM) document UP19[9] requires that where air is supplied by mechanical means, it should be a maximum of 85% of the total extracted volume. The remaining 15% is supplied from the areas adjacent to the kitchen, so maintaining a positive flow of air into the cooking area. BS 6173 more directly requires that sufficient air is provided for both combustion and the removal of combustion products, steam and associated contaminants. The British Standard also outlines the need for an interlock that will isolate the gas supply, in the event that the mechanical ventilation system fails.

Figure 1: Automatic gas isolation valve

Most of the cooking appliances would be under a canopy and designed to operate without a flue (known as 'Type A' under the European scheme for classifying gas appliances, CEN CR 1749[10]). Others, such as some types of convection ovens and deep fat fryers, can require connection to a dedicated flue ('Type B').

The UK Gas Safety (installation and use) Regulations allow for both types of equipment to be installed under a canopy, deeming it a 'power operated flue', requiring an interlock that will shut off the gas supply to the appliances in the event of an air movement failure. Therefore, an extract canopy will be incorporated in the majority of commercial kitchens – particularly those utilising gas – regardless of the type of appliances.

Interlocking methods

For interlocking the gas supply with mechanical ventilation, an automatic isolation valve (AIV – as in Figure 1) that conforms to BS EN 161[11] will need to be incorporated.

Such a valve would be linked through a control panel (such as that shown in Figure 2) that will normally be sited, for ease of use, next to any fan speed controllers. The panel should be fitted with an on/off switch or key and an emergency stop button, and an LCD display can be included to provide a simple – and contextualised – set of user instructions or status (as, for example, shown in the detail of the display in Figure 3). The fan operation is usually measured either by an airflow pressure differential switch or electrical current monitoring. The latter is an acceptable method provided that, where belt drive fans are used, the belt system has slippage and failure monitoring incorporated. Overrides are not allowed[1,9] on interlock devices; otherwise cooking could take place in the absence of effective ventilation, so risking the health and safety of occupants.

Carbon dioxide monitoring as an air quality proxy

Measuring CO_2 levels in a kitchen as an air quality indicator is a useful addition to an interlock system. When installed correctly, this can give an early indication of deteriorating air quality that may be caused, for example, when extract canopy grease filters have not been

Figure 2: An integrated ventilation interlock, leak detection, CO_2 monitoring and gas safety system

correctly cleaned. CO_2 detector heads must conform to BS EN 50543,[12] and only sensors specifically designed for commercial and light industrial use should be employed in a commercial kitchen.

However, the monitoring of CO_2 levels should not be relied upon to act as the signal for a primary safety device or interlock, unless only one Type A appliance is installed. For a short while, the now withdrawn Gas Safe Register TB140 guidance (superseded by IGEM UP 19) allowed CO_2 detectors to act as a secondary interlock in the event of a fan failure, but this is no longer an acceptable method.

Any safety device must failsafe so that, in the event of its failure, the gas will be isolated. A CO_2 detector head cannot be failsafe, since the device could be rendered ineffective by grease. Even with a filter-protected detector head, it is still not possible to treat it as failsafe, as it relies on the filter being changed on a regular basis.

A ventilation interlock system with any connected CO_2 sensors should provide a 'pre-alarm' at 2,800ppm. If the CO_2 concentration increases, an interlock incorporating an LCD display should indicate to the user that the ventilation level needs to be increased, and that the grease filters may require attention. At 5,000ppm, the interlock must[9] isolate the gas supply to the appliances.

Solid fuel use and carbon monoxide monitoring

As a response to the increasing use of wood and charcoal ovens in restaurants, the HSE has released catering information sheet 26: *Preventing exposure to carbon monoxide from use of solid fuel appliances in commercial kitchens*. This suggests the use of CO sensors where a solid fuel cooker is installed. It also states that the sensor should be interlocked with the canopy fan fitted above the oven, so that the canopy remains on when the CO concentration is over a prescribed maximum, even when cooking has ceased. Such solid fuel installations will also fall under the UK Control of Substances Hazardous to Health (COSHH)[13] Regulations and the Building Regulations.

Gas safety

The supply of gas into the kitchen needs to be controlled and monitored to ensure maximum safety. IGEM UP1A[14] points out that closing the AIV can result in the complete loss of pressure on the downstream side of the AIV. This would then require a tightness test, and possibly purging (on large installations), before cooking can recommence. This loss of pressure can happen even with flame safety devices fitted on appliances, because they will allow gas to burn for up to 10 seconds following the closure of the AIV as the pressure decreases, resulting in a loss of pressure downstream of the AIV. Pressure can even be lost downstream overnight when the AIV is closed, because of allowable leakage.

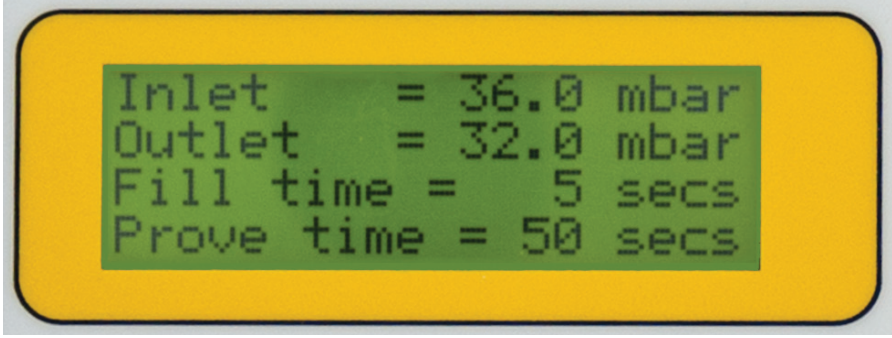

Figure 3: An LCD display ensures not only that the kitchen operative has simple contextualised instructions but also displays engineering information to simplify installation and diagnosing connected services

The interlock can be integrated together with a gas safety, monitoring, and gas-proving system. Gas pressure-proving as an integrated part of the ventilation interlock provides a means of ensuring that no gas leaks are present when such a system is turned on. It also overcomes the issue of low pressure downstream of the AIV, as described above.

A recently developed failsafe system tests the full function of the AIV each time the system is operated to ensure that the panel does not receive erroneous information, leading to an uncontrolled situation, such as an undetected gas leak. This is available on systems that continuously measure the gas pressure on both sides of the AIV – even before the AIV is opened by the panel – to carry out the pressure-proving test on the gas supply to the appliances.

Conclusion

The commercial production kitchen could be a high-risk place to work in. Yet, in the UK, incidences that fall under Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) related to carbon monoxide are very low.[15] This reflects well on the designers, maintainers and operators, and is underpinned by the appropriate application of properly controlled gas supplies, cooking appliances and associated ventilation systems.

However, this is not a signal for complacency, as there is a body of evidence that chronic exposure to relatively low levels of contaminants can have significant effects on long-term health. Properly designed and controlled integrated ventilation systems are likely to become increasingly important.

References:

1 BS 6173 *Specification for installation and maintenance of gas-fired catering appliances for use in all types of catering establishments (2nd and 3rd family gases)*, BSI, 2009.

2 Dennekamp, M et al, *Ultrafine particles and nitrogen oxides generated by gas and electric cooking*, Occupational and Environmental Medicine, August 2001.

3 **http://ehp.niehs.nih.gov/122-a154/**, accessed 27 December 2015.

4 *Statement on the evidence for the effects of nitrogen dioxide on health*, **www.gov.uk/government/publications/nitrogen-dioxide-health-effects-of-exposure**, accessed 27 December 2015.

5 Faustini, A et al *Nitrogen dioxide and mortality: review and meta-analysis of long-term studies*, European Respiratory Journal 44, 2014.

6 Penney, D et al, *WHO Guidelines for Indoor Air Quality: Selected Pollutants*, **www.ncbi.nlm.nih.gov/books/NBK138710/**, accessed 27 December 2015.

7 EH40/2005 *Workplace exposure limits – Second edition 2011*, HSE.

8 *Selected pollutants: WHO guideline for indoor air quality*, World Health Organization, 2010.

9 IGEM/UP/19 with amendment January 2015, *Design and application of interlock devices and associated systems used with gas appliance installations in commercial catering establishments*', IGEM, 2015.

10 PD CEN/TR 1749:2014 *European scheme for the classification of gas appliances according to the method of evacuation of the combustion products*, BSI, 2014.

11 BS EN 161:2011+A3:2013 *Automatic shut-off valves for gas burners and gas appliances*, BSI, 2013.

12 BS EN 50543:2011 *Electronic portable and transportable apparatus designed to detect and measure carbon dioxide and/or carbon monoxide in indoor ambient air. Requirements and test methods*, BSI, 2011.

13 Control of Substances Hazardous to Health 2002, **www.hse.gov.uk/coshh/**.

14 IGE/UP/1A Edition 2 *Strength testing, tightness testing and direct purging of small low pressure industrial and commercial Natural Gas installations*, IGEM.

15 *Incidents reported in Great Britain relating to the supply and use of flammable gas*, HSE, October 2015, **www.hse.gov.uk/statistics/tables/ridgas1.xlsx**, accessed 27 December 2015.

Turn over page to complete module

Module 90

February 2016

medem

1. When burning gas before cooking starts, which of these is unlikely to be produced?

☐ A Acrolein

☐ B Carbon monoxide

☐ C Formaldehyde

☐ D Nitrogen dioxide

☐ E Particulate matter

2. What is the UK Health and Safety Executive limit for eight-hour weighted average CO for workplace exposure?

☐ A 7ppm

☐ B 8ppm

☐ C 30ppm

☐ D 81ppm

☐ E 200ppm

3. Why is it considered that identified cases of CO poisoning may well be significantly under-reported?

☐ A Because it has no impact at low levels over long periods

☐ B Because it is not recognised by WHO

☐ C Because it only occurs in commercial kitchens

☐ D Because it is difficult to measure CO

☐ E Because the symptoms mimic other health problems

4. Which of these is prohibited on a control panel that acts as a safety gas interlock device?

☐ A Connection to AIV

☐ B Emergency stop button

☐ C LCD display

☐ D On/off switch

☐ E Override switch

5. Which of these statements is true?

☐ A CO_2 detector heads cannot be failsafe

☐ B CO_2 detector heads are inherently grease tolerant

☐ C CO_2 detectors can act as a secondary interlock in the event of a fan failure

☐ D CO_2 levels can be used as a signal for a primary safety device for a deep fat fryer

☐ E CO_2 sensors on a ventilation interlock system should provide a 'pre-alarm' at 5,000ppm

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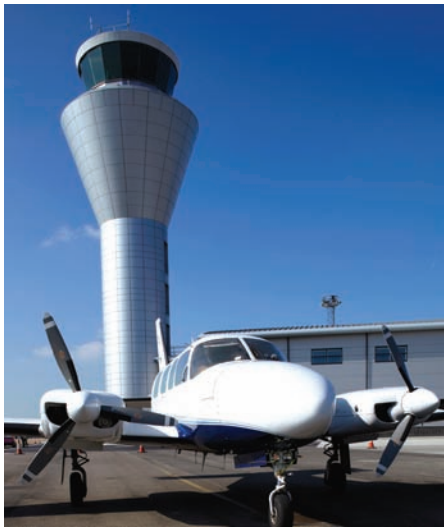


Humidity matters at Jersey Air Traffic Control

Four Condair steam humidifiers have recently been installed by Jersey Air Traffic Control in its centre at Jersey Airport.

Condair resistive steam humidifiers feature a scale-collection tank for easy and straightforward maintenance. The Condair CP3 Mini units are compact and discreetly designed electrode boiler humidifiers – wall-mounted in the areas concerned – to deliver up to 4kg/h of pure steam directly into the space. Routine maintenance is quick and kept simple by the easily exchanged boiling cylinders.

● **Visit www.condair.co.uk**

Smart new motion sensor cuts building energy waste

Adcock Refrigeration and Air Conditioning has introduced a retrofit control system that automatically turns off air conditioners in vacated rooms, helping to reduce energy use and carbon emissions.

The standalone attendant control system is designed for split air conditioning. Battery or mains operated, it can be discretely wall or ceiling mounted in any room, monitoring movement 24 hours a day.

● **Call 01223 550 220, email enquiries@adcock.co.uk or visit www.adcock.co.uk**

Chessun to raise awareness of occupant wellbeing at ACR Show

HygroMatik's national sales manager – and chair of the Federation of Environmental Trade Associations' Humidity Group – Andie Chessun, will present the white paper *Humidity and its Impact on Human Comfort and Wellbeing in Occupied Buildings* at the 2016 ACR Show, to raise awareness of occupant wellbeing.

HygroMatik offers a full range of long-lasting and easily maintained air humidifiers and air humidification systems.

● **Call 02380 443 127, email info@hygromatik.co.uk or visit www.hygromatik.com**

'Outstanding' energy efficiency in city centre

Air movement specialist Gilberts of Blackpool is responsible for the ventilation of the Filwood Business Park, in Bristol, which has achieved BREEAM Outstanding at design stage.

The buildings feature Gilberts' Mistrale natural ventilation solution, using single-sided ventilation in a cellularised arrangement. Gilberts' Type WPZ/50 high-performance louvres, with its Mistrale VN/75 high-efficiency insulated dampers and 220 deep attenuators, modulate fresh air drawn in at low level, with the used internal air exhausted at high level.

● **Call 01253 766 911**

London college uses Cygnus wireless fire alarm system during building development

Contractors doing construction work at Westminster Kingsway College have employed 200 of Bull Products' Cygnus wireless fire alarm devices.

The Cygnus system can link 480 units in 15 zones. Individual units may be a fire alarm call point, first aid alert point, smoke detector, heat detector or a combined call point and first aid alert alarm. A major feature is the optional control panel and event log.

● **Call 0844 669 1111, email info@bullproducts.co.uk or visit www.bullproducts.co.uk**

Fusing two into one…

Air movement specialist Gilberts is extending its Mistrale Fusion Series (MFS) range, with a high-capacity version. This will complement the core MFS128 unit, which transfers 128l/s of fresh air per unit, mainly naturally, into a building.

The MFS256 delivers double the airflow capacity in one larger unit, and the number of penetrations through the building façade is halved. The high-capacity version provides a dynamic hybrid natural ventilation solution that uses occasional eco fan assistance.

● **Call 01253 766 911 or email info@gilbertsblackpool.com**

JS Air Curtains' new product catalogue

Air curtain specialist JS Air Curtains has launched its new product catalogue. This provides detailed information on its range of exposed, recessed, industrial and revolving-door units, and incorporates quick-glance product options and performance data tables for each model.

Tim Scott, the company's head of sales, said: 'The comprehensive range of all air curtain applications makes this catalogue the "go-to" resource for air curtain selection and expert advice.'

● **Visit www.jsaircurtains.com/catalogue to download or request a copy**

Saving energy with ControlZapp

Danlers' ControlZAPP programmable lighting control has been used as part of a system suitable for switching and dimming LED lighting panels at the offices of gas-analysis specialists Servomex, in Crowborough, East Sussex.

Richard Allison, project director for AMG Electrical Services, said: 'We found that Danlers ControlZAPP ticked all the boxes. This programmable device, with Bluetooth smart communication, was straightforward to install and enabled Servomex to have full control over the entire LED lighting system.'

● **Email sales@danlers.co.uk or visit www.danlers.co.uk**

New year, new website for Ecoflam

Ecoflam has launched a new website dedicated to the UK burner market. Showcasing the company's range of domestic, commercial and industrial burners, the site features detailed product information, plus new photography.

It provides a user-friendly interface, as well as a product selector that helps visitors to identify the burner model best suited to the application, filtering by 'fuel' and 'type'. There is also a burner and spares locator.

Each product page includes downloadable manuals, brochures and technical specifications.

● **Call 01905 788 010 or visit www.ecoflam.co.uk**

UK arrival of new wood gas CHP

UK-based Fröling distributors Freedom Green Energy has launched the new Fröling wood-chip biomass gasification (CHP) unit, rated at 50kW electric and 100kW thermal.

These units come pre-commissioned, and only require connections on site and a wood-chip storage solution. The chip must be at 10% MC or below, and G30 specification.

The CHP is capable of continuous operation, running 8,000hrs per year. This creates a solution for sites requiring both heat and electricity simultaneously.

● **Call Rob Sherwin on 0333 7000 275**

A star is born

Grundfos Pumps will supply a range of equipment to a new development in London SW1, called Nova. The development – made up of five new buildings – will occupy an island site opposite Victoria Station, and shares a postcode with famous historical landmarks such as Pall Mall, Whitehall and Buckingham Palace.

The mixed-use scheme will include 870,000ft^2 of high-end offices, luxury apartments, top-class retail outlets and eateries, as well as community space.

For such a large project, many parties have been working in close collaboration and Grundfos Pumps has been involved to ensure that all the site's complex HVAC services and water demands are met.

The development is designed as a seven-day destination hub that will offer true city facilities to the local residential population, as well as to a vast number of visitors and commuters who will be able to enjoy this new venture.

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

Birmingham school improves energy efficiency with new Elco boilers

Elco has supplied three 85kW Thision L boilers to Holly Hill Infant and Nursery School, in Birmingham. The boilers were installed on a freestanding cascade frame with a low loss header. An Elco Extended Service Package was included to ensure the boilers remained efficient for their life-cycle.

Thision L is a range of light commercial gas-fired, high-efficiency, wall-hung condensing boilers, with outputs from 48kW to 145kW and a double helix stainless steel heat exchanger.

● **Visit www.elco.co.uk**

Hamworthy Heating's website wins National Construction Marketing Award

Hamworthy Heating won the Best Use of Website accolade at last week's Construction Marketing Awards. The awards celebrate creativity, innovation and effectiveness in marketing in the construction industry.

Hamworthy Heating launched its new website in February 2015 and has experienced a 148% increase in visitors from organic search. The firm faced stiff competition in its category, as the awards attracted a record number of entries.

● **Call 01202 662 510 or email pr@hamworthyheating.com**

Rehau emphasises commitment to the environment

Renewables, underfloor and district heating specialist Rehau has published a 44-page sustainability report that demonstrates its commitment to the environment.

Available to read on, or download from, the company's website, the report gives a clear account of how Rehau is performing in reaching its energy-reduction and recycling targets. It also gives an insight into some of the exciting environmental initiatives happening across the Rehau group at sites around the world.

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

Savile Row refurbishment overcomes height restrictions with AET Flexible Space

AET Flexible Space has supplied its underfloor air conditioning system and bespoke teak-finish, raised-access flooring to a height-restricted refurbishment at 28 Savile Row, Mayfair, central London.

Fully conditioned air is fed into the plenum by zonal downflow units (conditioned air module - CAM) and is introduced into the space via floor-recessed fan terminal units, or fantiles.

The system features integrated controllers that allow users to adjust temperature and fan-speed settings.

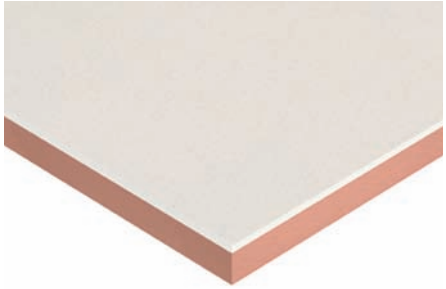
● **Call 01342 310 400 or email lucy@flexiblespace.com**

Ideal Commercial boilers provide optimum environment for priceless artwork

Two Imax Xtra 480kW floor-standing condensing gas boilers, from Ideal Commercial, have been installed at the Walker Art Gallery, Liverpool. They will help deliver carefully controlled, high-efficiency space heating while reducing running costs and emissions.

In addition to its compact footprint, the Imax Xtra has been designed to allow ease of access to the boiler's interior – via the sides and the top of the unit – ensuring maintenance is straightforward even within limited space.

● **Call 01482 492 251, email commercial@idealboilers.com or visit www.idealcommercialboilers.com**



Soffits sorted with the return of Kooltherm K10 Plus

Kingspan Insulation's Kooltherm K10 PLUS Soffit Board is back by popular demand, featuring a non-combustible external facing for outstanding fire and thermal performance.

The 1.2m x 2.4m boards are suitable for ceiling applications beneath a conditioned floor, such as within underground car parks. Their fibre-free insulation core holds a Class 0 fire rating, with negligible smoke obscuration, and is pre-bonded to the non-combustible outer layer. The lightweight insulation boards can easily be mechanically fixed in place.

● **Call 01544 387 384, email info@kingspaninsulation.co.uk or visit www.kingspaninsulation.co.uk**

New fast-coupling wire basket lives up to its name

Two steps in four seconds is all it takes to install Marshall-Tufflex's latest product – the fast-coupling wire-basket system.

Suitable for industrial, commercial, renewable energy and transportation installations, fast-coupling wire baskets are quick and easy to assemble without tools, thanks to a push-fit coupler.

The baskets – available in 65mm and 105mm heights – have a unique rippled wire construction and are corrosion resistant, making them suitable for use in harsh environments.

The system offers maximum cable ventilation and is finished in electro-zinc.

● **Email marketing@marshall-tufflex.com**

Kingspan insulation reports further sustainable success

Kingspan Insulation has published its latest *Sustainability & Responsibility* report, highlighting a year of continued growth and sustainable development.

To ensure transparency, the report has been compiled under the rigorous requirements of the Global Reporting Initiative framework level B+ and is backed by external assurances.

The report highlights the continued work towards net zero energy across all Kingspan Insulation sites. A range of energy-saving measures has been implemented at the firm's manufacturing facility in Herefordshire.

● **Call 01544 387 384, email info@kingspaninsulation.co.uk or visit www.kingspaninsulation.co.uk**

Rinnai UK's technical know-how on tap

Rinnai UK, supplier of A-rated, continuous-flow Infinity gas-fired water heaters, has a dedicated technical service team to ensure customers get service performance to match the quality of its product performance.

Rinnai Technical Services offers customers help and advice throughout the complete life-cycle of a product – from inception to disposal. The team will respond to any queries on specification, installation and operation of Rinnai units.

Installers can also request free training from the Rinnai technical department.

● **Visit www.rinnaiuk.com**

Remeha boilers keep it warm at Chatham Historic Dockyard

Chatham Historic Dockyard Trust has installed Remeha boilers in three of its buildings, to refurbish the heating of these Scheduled Ancient Monuments and ensure their long-term use.

PCS Consulting Services specified two Remeha Quinta Pro 115 boilers in cascade at the Sail & Colour Loft, a Remeha Gas 210 Eco Pro boiler at the Royal Dockyard Church, and two Remeha Gas 210 Eco Pro boilers at the Admiral's Offices, to meet the Trust's complex heritage challenges.

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

Rinnai makes a splash at the Hale Country Club and Spa

Rinnai A-rated, continuous-flow hot-water heaters are keeping things flowing at the Hale Country Club & Spa, in Cheshire.

As well as providing an unending supply of temperature-safe hot water for clients, the Rinnai units guarantee low running costs and prevent any worries for the operator about Legionella.

Operator FX Leisure installed 17 Rinnai HDC1500i gas-fired condensing units to fulfil the club's demand for 20,000 litres per hour of hot water.

● **Visit www.rinnaiuk.com**

Lochinvar goes Aloft to reach peak demand

Boiler and water heater manufacturer Lochinvar supplied three EcoShield high-efficiency water heaters as part of the refurbishment of one of Liverpool's most iconic buildings. The Grade II-listed Royal Insurance Building, which had been disused for more than 20 years, has been remodelled and reopened as the Aloft Hotel.

Three direct gas-fired EcoShield SHW115-435CE high-efficiency water heaters were chosen because of their ability to provide up to 6,000 litres of hot water per hour working in combination. Each compact water heater can store up to 425 litres; and their fast recovery performance means they can respond quickly at times of heavy demand. They use condensing technology to keep energy costs as low as possible and employ 5:1 burner modulation, meaning they can also ramp right back to supply steady amounts of hot water at times of lower demand. The heater's stainless steel heat exchanger is robust and durable, while the integral storage vessel is covered by a five-year warranty.

● **Visit www.lochinvar.ltd.uk**

Superstore on course to save £52,000 thanks to KalGUARD limescale control

A large supermarket in Wisbech, Cambridgeshire, is on course to achieve savings of £52,000 over an eight-year period, after its decision to install a KalGUARD/CTU water-treatment system from Sentinel.

Sentinel's KalGUARD – an electrolytic scale inhibitor kit for commercial hot and cold water systems – is independently proven to protect premises against the damaging and expensive impact of limescale in hard-water areas.

Once installed, the device is extremely low maintenance, and servicing is recommended just twice a year.

● **Visit www.sentinelprotects.com**

Sika Liquid Plastics' solution allows Asda store to remain open during roof refurb

An Asda supermarket in Scunthorpe has benefited from a roof refurbishment using Sika Liquid Plastics' built-up roof waterproofing system.

The project, which was completed in just 10 weeks, required expert planning by contractor Ice Roofing, a Sika Liquid Plastics Quality Assured contractor.

Sika Liquid Plastics' Decothane Gamma 20 roof-coating system was applied over the entire roof area. The cold-applied, zero-flame, zero-heat, built-up roof system allowed the store to remain operational throughout the works.

● **Call 01772 25978**

Sontay sensors help create the perfect climate at the new Gold Stone Centre

The construction of the new Gold Stone Centre in Beijing, China, required a sophisticated building management system (BMS) featuring a vast number of Sontay sensing and measuring devices. These were installed by Netherlands-based building automation specialist Air Traxx.

The project is due for completion this year. Air Traxx has installed several Sontay products, including temperature sensors, Air DP sensors, and liquid pressure sensors. Sontay TT-341 immersion sensors have also been used in the buildings.

● **Contact sales@sontay.com**

Holland Heating AHUs from Systemair

Holland Heating air handling units (AHUs) are now available direct from Systemair UK. The HH Flex range covers bespoke AHUs with duties up to 34m³/s and includes side-by-side units, HTM-compliant hospital spec units, and ATEX-rated AHUs. Holland Heating's factory, in Waalwijk, has more than 50 years' experience in the AHU market and offers full factory witness testing. Holland Heating became part of the Systemair group in 2013.

● **Email info@systemair.co.uk or visit www.systemair.co.uk**

PRODUCTS & SERVICES

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

Waterloo's Plasterline grille delivers discreet functionality

Waterloo Air Products has expanded its product range, targeting the prime and super-prime residential market with the launch of Plasterline linear grilles.

There are four models in the range, each produced to integrate into a building's design. Once fitted within a wall or ceiling, the Plasterline grille provides a subtle, but structured, appearance without compromising air flow. It can be used in modular or continuous situations, with ceiling, sidewall, sill or bulkhead applications.

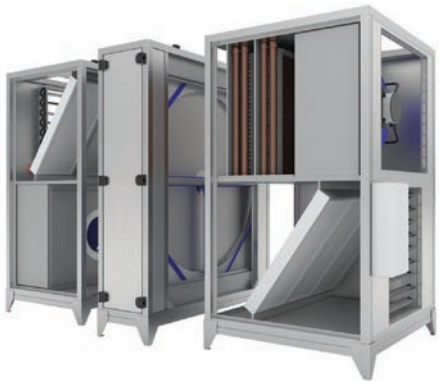
● **Email alan.smith@waterloo.co.uk or visit www.waterloo.co.uk**

Weatherite apprentice scheme continues to grow

West Bromwich-based Weatherite Air Conditioning continues to benefit from its long-held commitment to the Modern Apprenticeships scheme.

The company, which designs and manufactures heating, ventilation and air-conditioning equipment, has recently taken on a further 10 apprentices. It is reaping the rewards of its investment in the scheme, with a steady flow of high achievers – many of whom choose to carry on with their education after the apprenticeship scheme is completed.

● **Call 0121 665 2266 or email Robert Boswell on rboswell@weatheritegroup.com**



Airflow to share innovation and expertise at the ACR show 2016

Ventilation solutions manufacturer Airflow Developments will showcase the new Duplexvent rotary thermal wheel ventilation system at the ACR Show 2016, being held at the NEC Birmingham from 16-18 February.

The system – in rooftop or indoor versions – is a significant innovation in compact mechanical ventilation with heat recovery. It uses a rotary thermal wheel to achieve up to 85% heat recovery and air volumes of between 8,000 and 16,000m^3/hr.

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

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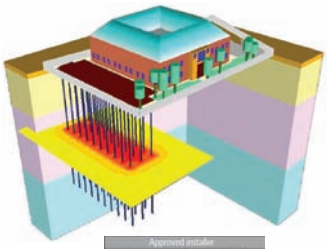

Ventilation and Air Conditioning

HUB OF KNOWLEDGE

CREDIT: bit.ly/1RBnR5G

Four centres of excellence in sustainable building design have been set up by the Royal Academy of Engineering. **Rachel Cruise**, from the University of Sheffield, explains its aims

Following its report *The case for centres of excellence in sustainable building design*, the Royal Academy of Engineering (RAEng) established centres of excellence at four universities: Heriot-Watt, Loughborough, Sheffield and University College London. Their aim is to lead the exchange of best practice in teaching and research for the sustainable built environment.

What is the role of a RAEng centre?

The RAEng report highlighted the significant shortfall in the number of graduates with sustainable building design skills, needed to achieve a step change in the environmental impact of the industry. The four centres signed a concordat earlier this year to address this issue, both through their individual programmes and by acting together as a hub for the generation and dissemination of knowledge needed to address the climate challenge.

How can universities encourage more collaboration and integrated design?

Developing graduates who have the skills to successfully communicate and work with other built environment professionals is key to creating holistic, sustainable designs. Successful interdisciplinary learning can, however, be a huge challenge for course designers, tutors and students because of the range of design approaches and languages that define the different professions in the construction industry.

More programmes that bring together disciplines to create graduates with the skills to work across the professions have recently started up in the UK. However, gaining validation from more than one accreditation body to ensure their regulation and recognition can be difficult. It is therefore important for universities to work with all accreditation bodies and all industry sectors to develop both a common language and a professionally recognised pathway between the distinct professions.

> Finding ways to retain skilled professionals in the field is just as important as recruiting them

How can the UK better prepare its young engineers?

We need to consider how all members of the construction industry – not just engineers – can be better prepared. This includes the designers, who create the initial proposal, through to contractors, whose method of construction is important to achieve the desired performance. It is difficult to predict the nature of the industry that students will experience during their working life. They need to be able to define what the challenges are in unknown situations and value what other specialists can contribute in formulating a response.

Are maths and physics a must for such a programme?

It is hard to imagine any qualification related to the construction sector that does not use mathematics, if only at a very basic level. This is because maths underpins how the performance of the built environment is frequently quantified, predicted and evaluated. However, while knowledge of maths and the sciences is important, they are not the only skills needed to reduce our environmental impact. Influencing how we choose to inhabit our environment requires very different skills. So the question could be changed to: Do students need to be able to formulate and communicate a critical argument? I would argue that all students need both skills at some level since this starts to form a common language across all sectors of the construction industry.

How do we ensure graduates offer what the industry needs?

Universities work with industry professionals to determine the required attributes of graduates. This includes engaging them as part-time lecturers or tutors on design projects, or asking them to contribute to external review and professional accreditation panels that help maintain programme standards and relevance. The ease of engaging practitioners in influencing education can change depending on the buoyancy of the construction industry. This is where funding opportunities for individual universities to develop an ongoing exchange with practising professions, such as the RAEng Visiting Professors scheme, are vital.

Can more women be encouraged to take careers in the built environment?

The built environment needs increasing numbers of people committed to developing and promoting a sustainable way of living. Universities, industry and all professional bodies need to work together to help all young people be aware of all the different career opportunities within the construction industry. However, finding ways to retain skilled professionals in the field is just as important as recruiting them, such as ensuring work environments support a healthy work-life balance, equal pay and equal opportunities.

● **RACHEL CRUISE** is a lecturer in structural design at the University of Sheffield

Events & training

NATIONAL EVENTS AND CONFERENCES

CIBSE Building Performance Awards
24 February, London
The winning projects will be unveiled at this high-profile awards night, hosted by Louise Minchin.
www.cibse.org/bpa

Ecobuild
8-10 March, London
Visit CIBSE on stand E4190, where it will host one-to-one membership workshops and showcase its latest projects.
www.ecobuild.co.uk

CIBSE Technical Symposium
14-15 April, Edinburgh
The 2016 Technical Symposium will take place at Heriot-Watt University, Edinburgh. The symposium has the theme 'Integration for whole-life building performance' and more than 60 papers will be presented across the two days.
www.cibse.org/symposium

CPD TRAINING

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

Lighting design: Principles and application
9 February, London

Fire sprinkler systems design
10 February, London

Building services explained
10-12 February, Manchester

Energy Building Regulations: Part L
11 February, Birmingham

Energy system ISO50001 (ESOS compliant)
12 February, London

Designing water-efficient hot and cold supplies
17 February, London

Standby diesel generator
18 February, London

Preparing FM and maintenance contracts
19 February, London

Mechanical services explained
23-25 February, Manchester

Understanding psychometric charts
26 February, London

Emergency lighting to comply with fire safety
26 February, London

Electrical services explained
1-3 March, Manchester

Energy surveys
3 March, London

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

Introduction to building services
4 March, London

Sanitary and rainwater design
8 March, London

ENERGY ASSESSOR TRAINING

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

EPC training
3-4 February, London

Heat networks consultants training
9-10 February, Glasgow

LCC building operations/ DEC training
23-25 February, London

Heat networks consultants training
1-2 March, Manchester

Air conditioning inspectors training
2 March, London

LCC design/EPC training
8-9 March, Birmingham

Heat networks consultants training
9-10 March, London

LCC building operations/ DEC training
15-17 March, Manchester

CIBSE GROUPS, REGIONS AND SOCIETIES

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

East Midlands Region: Renewable energy storage
2 February, Northampton

Ireland Region: CFD/ thermal modelling
3 February, Dublin

FM Group: Saving energy, improving system longevity and optimising performance
3 February, London
By Richard Wall, technical and product director at Fernox.

Lifts Group: AGM and evening meeting
9 February, Balham

East Midlands Region: Utility connections
9 February, Kegworth

North East Region: BS11000
9 February, Newcastle upon Tyne

Climate-based daylight modelling: The what, the why and the how
10 February, London
Talk by Loughborough University's Eleonora Brembilla and Professor John Mardaljevic.

West Midlands Region: Pressure vessels
10 February, Birmingham
Presentation on the need for and application of air/ dirt removal equipment and balanced pressurisation systems.

Southern Region: Water safety management
11 February, Brighton

HCNW Region: What does still work around here? Disasters recovery
11 February, London
John Taylor, previously of the Royal Engineers, talks about disaster recovery.

School Design Group AGM
15 February, London
CIBSE SDG's AGM will be held as part of one-day conference hosted by the UCL Institute for Environmental Design and Engineering.

North West Region and YEN NW: Guide A launch
18 February, Manchester
Launch of the new edition of CIBSE Guide A, presented by the authors.

SoPHE Scotland seminar
18 February, Edinburgh
Creating the ideal washroom environment, by Geberit.

East Midlands Region: TM53 Refurbishing non-domestic buildings
23 February, Kegworth

Façade 2015: Project of the year
24 February, London
Society of Façade Engineering presents the winner.

West Midlands Region: Design optimisation… making rigorous cost-benefit simulations
24 February, Birmingham
Presentation on an innovative approach to aid the design process, using optimisation in a simulation tool to undertake rigorous cost-benefit analysis.

Society of Light and Lighting and HCNW Region: The HCNW lighting paper at GX: The Lighting Controls Guide
24 February, Chalfont St Peter
Sophie Parry and Simon Robinson will review the new guidance and discuss ongoing developments.

Effective grease management systems for food-processing areas
25 February, Bristol
Talk by ACO Building Drainage.

Inside Out: Light and Architecture

SLL masterclass series

The Society of Light and Lighting (SLL) masterclass series 2015-16, titled 'Inside out: Light and architecture', illustrates the importance of cross-industry collaboration. It focuses on how lighting and architecture can – and must – work together to enhance interior or exterior spaces.

In each session, a leading professional will deliver a guest paper and will be followed by a 'master' from each of the series' sponsors.

Mike Simpson, from Philips, will present 'Lighting for public spaces', looking at: pedestrians at night and how to build spaces for people; how technology enables lighting to transform public spaces; and how technology can increase engagement and make spaces great.

Kevin Stubbs, from Thorn, will talk on 'Lighting for architecture: The outdoor environment'. He will discuss the appropriate lighting design, focusing on when, where and how we should use light. He will also look at the importance of empathy with the environment through lighting design.

Helen Loomes, from Trilux, will present on 'Form and function in harmony – lighting the interior'. She will look at how light reacts to different spaces, surfaces and colours, and how light might be used to add to the dynamic appearance of space.

Finally, Xicato's Roger Sexton will present the paper 'The future of lighting is smart', which sets out a vision of smart lighting and looks at which functions can be integrated into smart luminaires, as well as the means of communication between systems .

The sessions will be held on:

- 18 February, York
- 31 March, Belfast
- 13 April, Edinburgh
- 26 May, London

To book, visit **www.cibse.org/sll**


Mike Simpson


Kevin Stubbs


Helen Loomes


Roger Sexton

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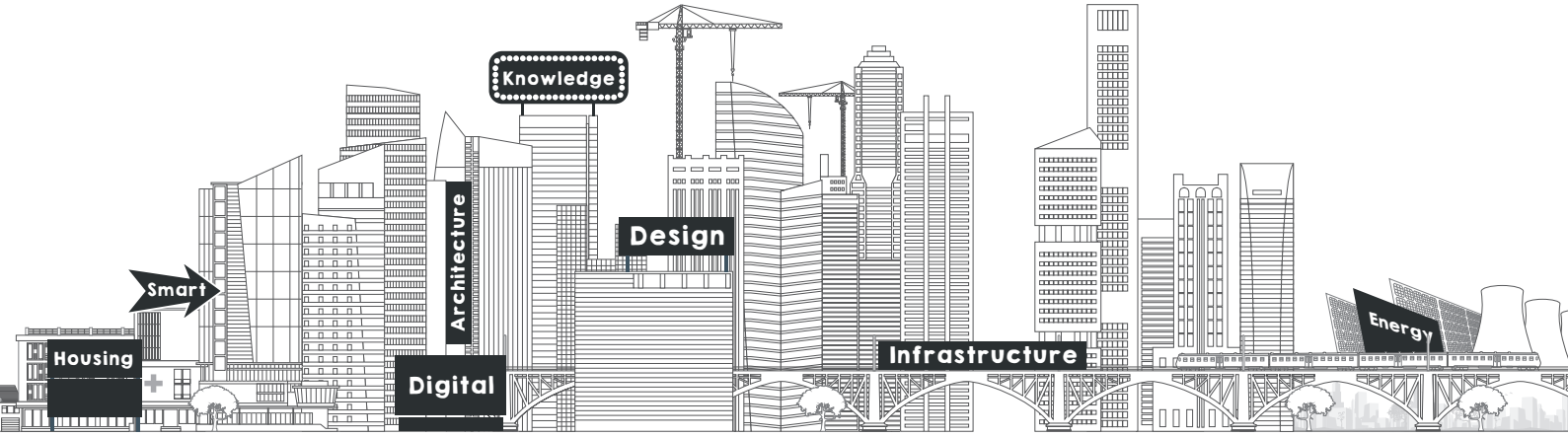

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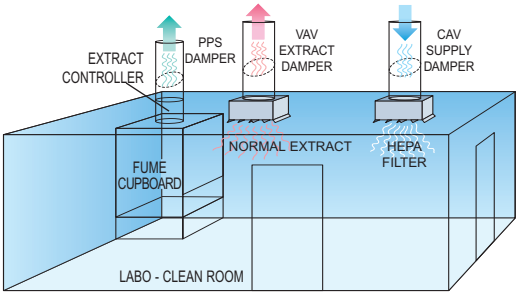

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