JOURNAL CIBSE

The official magazine of the Chartered Institution of Building Services Engineers

September 2014

RENEWABLE CHECKLIST
Ensuring operation matches design intent

STREET SMART
How intelligent lighting is transforming urban space

JUST WHAT THE DOCTORS ORDERED

Arup unravels the DNA of the new Francis Crick Institute

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The Renewable Solutions Provider
Making a World of Difference

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Reaping the harvest

It's set to be a bumper few years for the building services industry in the UK. The south east's strong economic revival is rippling out to the rest of the UK, and new regulations designed to improve the energy efficiency of building stock could result in lots more work.

Research by CO_2 Estates suggests that the requirement for Minimum Energy Performance Standards in 2018 could result in improvement works totalling £29bn (page 20).

The impending Energy Savings Opportunity Scheme (ESOS) – which helps to identify system inefficiencies – will also result in the overhaul of more plantrooms. Hywel Davies looks at the potential impact of ESOS, and says it will affect the rules covering air conditioning inspections. Currently, a lack of compliance means only 20% of systems covered by the regulations are being inspected. This will change because ESOS covers air conditioning systems – and the simplest way to do that will be to commission an inspection.

So, workloads look set to rise, but will engineers be able to make the most of the opportunities? There is growing evidence of a shortfall in capacity, due to a lack of skilled engineers. CIBSE Yorkshire committee member Simon Owen is a recruitment consultant dealing with the consequences of skills shortages. He says the industry must avoid the 'feast or famine' approach to recruitment, and invest in the long-term future of engineers. Otherwise, he warns, the industry won't be able to take full advantage of the good times (page 22).

> Workloads look set to rise, but will engineers be able to make the most of the opportunities?

Temperatures in the latter half of August may have cooled in the UK, but overheating has been a hot topic of conversation on social media and in the pages of the *Journal*. On the Feedback page, lighting engineer Ben Cullen gives a vivid description of what it's like to live in an inadequately ventilated home, while SE Controls' Chris Iddon explains his company's analysis of hot corridors – and how the issue could be rectified (page 16).

Iddon was on the shortlist for last year's CIBSE/ASHRAE Young Engineer of the Year Awards, and this year's shortlist is revealed on page 9. We also have news of speakers at the CIBSE Building Leadership Conference & Exhibition (page 12). There are some big names from across the industry, including Mark Hawker, head of engineering at Sainsbury's, and RIBA president, Stephen Hodder. The shortlist for the 2015 Building Performance Awards will be announced at the conference. There is still time to enter the awards – the closing date is 11 September.

Alex Smith, editor
asmith@cibsejournal.com

NEWS

All the latest news from around the building industry

In brief

NICK BOLES GETS CONSTRUCTION BRIEF

Former planning minister Nick Boles has been given responsibility for construction as Minister of State for Business, Innovation and Skills.

Liz Peace, chief executive of the British Property Federation, said she was pleased with this development, adding that Boles' background in planning would serve him well in his new role.

'His understanding of the issues that the commercial and residential property sectors face will be particularly helpful as he takes on this new patch,' she said.

'DECENT HOME' FUNDING BOOST FOR LONDON

The Mayor of London, Boris Johnson, has announced £145m of funding to improve the condition of affordable homes in the capital, and pay for energy-saving upgrades.

The mayor's office estimates that 175,000 homes will benefit from 'carbon-reducing renovations that could save residents up to £180 annually on energy bills'.

The money is available through the Decent Homes Fund, and will be distributed via London boroughs. Consultant Capita is also contracted to deliver £3m of energy-saving improvements, worth 'at least £50m' to London homes by 2017, the mayor's office added.

Rivers could be heat sources for homes and businesses

DECC produces map identifying 40 urban waterways that could host heat pumps

Rivers and estuaries across England could be tapped as sources of renewable heating for homes and businesses, according to the Department for Energy and Climate Change (DECC).

It has produced a map showing 40 urban rivers and estuaries where it wants to install water source heat pumps to replace traditional heating.

'Rivers and estuaries in cities and towns across England could provide clean, reliable heating to thousands of homes and businesses,' a DECC statement said. 'The map is designed to help local authorities, private developers and community groups identify prime locations to install large water source heat pumps, by aligning suitable bodies of water with areas where there is a high demand for heat.'

Energy and Climate Change Secretary, Ed Davey,

PETER JEFFREYS / SHUTTERSTOCK

said that – although it 'sounds like magic' – proven technology can 'extract some of the heat in our rivers and estuaries, and use that energy to heat our homes and offices.'

'If we can succeed on the large scale, it would cut Britain's import bill and boost our home-grown supplies of clean, secure energy,' added Davey.

Read our Kingston Heights case study at www.cibsejournal.com

Lift engineer takes charge in Iraq

The new prime minister of Iraq is a former electrical engineering student at the University of Manchester, and a successful lift engineer.

Haider al-Abadi takes over from Nouri al-Maliki at the height of the crisis in Iraq, as Islamic State militants terrorise towns and villages, threatening the break-up of the country. He will now oversee US air strikes and the efforts of the Kurdish fighters to beat back the onslaught.

THOMAS IMO / GETTY IMAGES

Abadi studied electrical engineering at Baghdad University in the 1970s and completed his PhD in Manchester in 1981. He returned to the UK after being exiled by Saddam Hussein and worked as a lift engineer. At one time, his company was responsible for servicing the lifts at the BBC's Bush House headquarters.

OFF-SITE APPROACH CUTS TIME ON SAW SWEE CENTRE

Shepherd Engineering Services (SES) used off-site manufacturing to shave four weeks off the project programme of the Saw Swee Hock Student Centre, at the London School of Economics and Political Science (LSE).

Working alongside the main contractor, Osborne, SES completed the design and installation of all M&E works for the £25m new-build project. It prefabricated two multi-service riser modules, including ventilation, wet services, and mechanical and electrical units.

Situated close to London's West End, the Saw Swee Centre is the first new building commissioned by the LSE in more than 40 years, and is on the shortlist for the RIBA Stirling Prize.

It has achieved BREEAM Outstanding accreditation, and incorporates a range of academic and support services, including a pub, media centre, and gym. It also has the offices that deal with student residences, accommodation and the LSE careers service.

Construction on track for 22% growth

The construction industry will grow by 22% over the next five years, according to the Construction Products Association (CPA).

Construction output will rise by 4.7% in 2014, and 4.8% in 2015, and will go on to match its pre-recession peak – reached in 2007 – by 2017, the CPA's latest forecasts reveal. Private housing starts are expected to increase by 18% in 2014, and by 10% in 2015. Commercial office output should grow by 10% this year and 8% in 2015, the CPA added.

'The forecasts reflect the increasing strength of the sector, though risks remain,' said CPA economics director Noble Francis.

'We anticipate the recovery will continue through the forecast horizon in 2018, and broaden across both sectors and regions.'

The activity will be led primarily by private housing, infrastructure and commercial offices in the short term, according to Francis, but work on schools and hospitals should also pick up in the longer term. However, he added, the pending general election 'will cast the future of housing policies into doubt', and uncertainty – together with questions about affordability and higher mortgage repayment costs – 'will likely subdue private housing growth to 5% per year from 2016'.

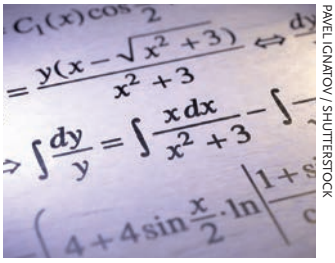
The commercial building sector will have a more profound influence in the longer term, and the CPA expects that to contribute 23.4% growth up to 2018.

More A level maths students

Maths was the most popular A level subject taken by sixth-form students in Britain in 2014, overtaking English for the first time in more than a decade.

The subject has grown from 52,788 entries in 2004 to 88,816 this year. Overall, A-level entries fell, but maths enjoyed a rise of 0.86% and more than 4,000 students. This trend has been hailed as good news for the engineering sector.

Science subjects also increased in popularity, and this was welcomed



PAVEL IGNATOV / SHUTTERSTOCK

by John Cridland, director general of the Confederation of British Industry.

'Growth and jobs in the future will depend on closing our yawning skills gap, and the UK having a workforce that can exploit new technologies, so it's great to see entries up in the sciences and maths,' he said.

'Highly skilled workers are essential for our growth sectors, so these qualifications carry a real premium with employers. It will be those young people with science and maths qualifications who go on to become engineers and new-tech entrepreneurs in the future.'

Daylighting in offices crucial for sleep

Good levels of natural daylight are vital for building occupants' sleep patterns, according to new research. The findings, published in the *Journal of Clinical Sleep Medicine*, make a connection between naturally-lit offices and the physical and mental health of workers.

Researchers from the University of Illinois, Northwestern University, in Chicago, and the Hwa Hsia Institute of Technology, in Taiwan, studied a sample of office workers and found that windows play a crucial part in regulating the human body's internal time clock.

Workers with the most exposure to natural light enjoyed an average of 46 minutes more sleep per night than colleagues who worked in windowless conditions.

'Office workers with more light exposure at the workplace also tended to have better sleep quality, more physical activity and a better quality of life,' the researchers said.

An office using good-quality artificial light will not produce the same benefits, health experts say, because office lighting does not operate on the same 'blue light' wavelength as sunlight, which controls the body clock.

BREEAM ambition is no more costly

Sustainable buildings are no more expensive to construct than traditional equivalents, claims a study by Sweett Group and BRE.

Aiming for high BREEAM ratings will add, at most, 2% to the overall cost of a project, and that money will be recouped through lower running costs, the study showed.

Researchers used cost data from actual construction projects and applied them to three case-studies – an office, secondary school and community healthcare centre – to produce detailed capital and operational cost information.

'The investigation of life-cycle operational costs showed that any additional cost can be paid back within two to five years through utility savings,' they said.

Architects hail 'smart' blinds

A prototype sunshade is gaining interest from architects struggling to make skyscrapers more resistant to solar gain.

The Sunbreak, developed by architects NBBJ, uses sensors to measure and respond to solar activity. When it's sunny, the shades close automatically; in cloudy conditions, solar panels built into the shades reflect sunlight into the interior to reduce the need for artificial lighting.

The three-hinged shade will automatically switch to energy-conservation mode when rooms are empty.

US losing out on female engineers

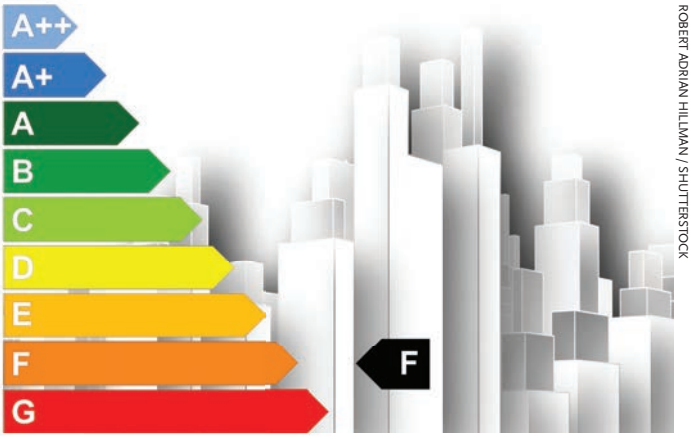
Nearly 40% of US women with engineering degrees leave, or never enter, the profession, according to the American Psychological Association.

A study of 5,300 engineering alumnae from the past six decades found that 11% never entered the field, 21% left more than five years ago, and 6% left less than five years ago.

Two-thirds left to pursue better opportunities in other fields, while a third stayed at home with their children because companies didn't accommodate flexible working, according to the research.

More than a third of buildings would fail proposed energy test

Upgrading properties could be prohibitively expensive



ROBERT ADRIAN HILLMAN / SHUTTERSTOCK

More than 35% of commercial buildings in the UK would fail to meet proposed Minimum Energy Performance Standards (MEPS), it has been revealed.

The Department of Energy and Climate Change (DECC) has launched a consultation on proposals for commercial landlords to be prohibited from renting out properties with energy ratings lower than E on their Energy Performance Certificate (EPC) from 2018.

Consulting engineers WSP said many buildings currently at E will have been downgraded to F by 2018 because EPC scoring will reflect more stringent Building Regulations. This means far more than the 18% of current stock estimated by DECC would fail to reach MEPS

WSP modelled five reference buildings to show how the EPC bandings have changed between 2008 and 2013, and then compared this with how the regulations will change by 2018.

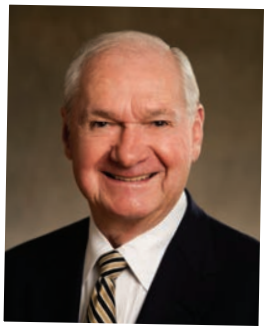
'Our research shows EPC ratings drop by half to one band each time the regulations change,' said Anna Walton, WSP's lead on EPCs. 'These proposals will have a significant impact on owners' ability to lease their buildings if they're adopted.

'Many property owners are already reviewing their buildings and developing proactive strategies in anticipation of the regulations, which is the right approach.'

The British Property Federation said the standards would have a 'significant influence on the future quality of the UK's rental stock', and that ensuring buildings have an E rating would 'require significant investment'. It added that, for some properties, it could be 'prohibitively expensive or difficult to upgrade to an EPC rating of E'.

Read Andrew Cooper's article on the implications for engineers of the proposed Minimum Energy Performance Standards on page 20.

Engineers pay tribute to former ASHRAE president Bill Coad



Former ASHRAE president Bill Coad has died after a short illness.

A graduate of St Louis University High School (1949) and Washington University School of Mechanical Engineering (1957) – from where he received a degree in engineering – Bill was a registered professional engineer in 37 states, and a life member of ASHRAE. He was president of the Society from 2001 to 2002.

Bill was president of Charles J R McClure Engineering Associates, where he specialised in HVAC systems for commercial building, educational and other institutions, and mentored many colleagues. At the time of his death, he was president of Coad Engineering Enterprises and Coad Consulting.

Bill loved teaching and for 29 years was an associate professor of mechanical engineering at Washington University. In 1992, the university's School of Mechanical Engineering presented him with its Distinguished Alumni Award. He wrote hundreds of articles for professional journals, as well as two books, including *Energy Engineering and Management for Building Systems*.

'He was always smiling, welcoming, interested, thoughtful and kind. It was a joy to bump into him at ASHRAE meetings,' said CIBSE ASHRAE Group chairman, Tim Dwyer.

Fellow former ASHRAE president Richard Rooley said he would miss their discussions 'about both the strong and the challenged parts of our industry'. 'He was scheduled to speak in our fellows debate next January, in Chicago, and his comments on either side of this debate would have been incisive and well worth listening to.'

Bill was married to Dorothy (Doodie) for 62 years.

Contractors report rising workloads

Specialist contractors are currently enjoying a healthy rise in workloads, according to the National Specialist Contractors' Council (NSCC).

In its latest 'state of trade' survey, 57% of contractors reported an increase in output for the second quarter of this year, up from 27% just over a year ago. The balance of orders – the difference between respondents reporting an increase and those reporting a decrease – also reached its highest level since 2000.

The NSCC said 59% of specialist contractors were 'anticipating an increase in workload over the next quarter, and a record high of 72% expect to see an increase over the next year'. Meanwhile, 84% of respondents reported that they are now working at more than 75% capacity, with 43% at more than 90% capacity.

However, this rate of growth is not without its negative side, and 64% of respondents said they were experiencing increased supplier prices, while 19% said they were unable to bid for work because of skills shortages.

There has been some improvement in payment practices, according to the council, with 16% of contractors getting paid in – on average – less than 30 days.

'Fair payment is vital to the continued long-term recovery of the sector,' a NSCC statement said. It also called for increased support for the Construction Supply Chain Payment Charter, which sets out a commitment to 30-day payment terms, and no retentions, by 2025.

Graduate of the Year shortlist announced


2013 winner William Holley

Nine young building services engineers have been shortlisted for the 2014 CIBSE ASHRAE Graduate of the Year Award.

The nine – who are each in with a chance of winning a trip to the ASHRAE Winter Conference in Chicago next January – are: Michael Enstone, Imperial College and Aecom; James Harker, London South Bank University; Abdul Wahab Malik, NED University of Engineering and Technology, and Meinhardt, Pakistan; Charlotte Mercer, University of the West of England and Aecom; Amelia Ng, University of Bristol and Arup; Richard Seaman, Dublin Institute of Technology; Kit Stormont, University of Bath and Buro Happold; Emilia Targonska, Loughborough University and Hoare Lea; Bryony Turtle, University of Bristol and Atkins.

The awards – supported by CIBSE, ASHRAE and the Institution of Mechanical Engineers (IMechE) – are sponsored by Daikin UK, Kingspan Tarec and Ruskin Air Management. The finalists will give a short presentation to the judging panel at IMechE's headquarters in London, at the awards event on Thursday, 9 October.

Winners of the Employer of the Year award will also be announced on the night.

The event is free and open to all, but you must book in advance: **www.cibse.org/yea**

CIBSE NEWS

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CIBSE ANZ meets Engineering Council CEO

Representatives from the CIBSE ANZ committee met Jon Prichard, CEO of the Engineering Council, in June in Sydney. Also present were: CIBSE President Peter Kinsella; Ian Small, NZ Region chair; Steve Hennessy, immediate past ANZ chair and Paul Angus, NSW chair. At the meeting Prichard gave an update on the UK-SPEC review, updated CPD code and general developments.

International links were made, which will further aid the CIBSE ANZ region appealing to building services engineers.

Be proud of your achievements

All members who have successfully achieved EngTech, IEng or CEng are able to use a personal registrant logo on correspondence to demonstrate their achievement. Registrants can download the relevant logo from the Engineering Council website at **https://ws.engc.org.uk/logoorders**

Final call: Share your knowledge

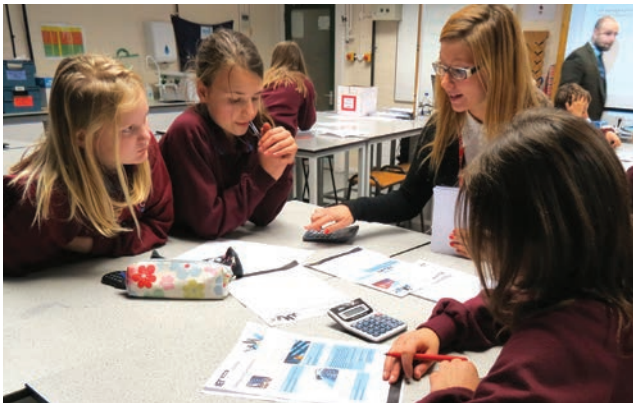
There is still time to submit your proposals for papers for the 2015 CIBSE Technical Symposium, to be held on 16 and 17 April 2015 at University College, London.

The 250-word proposals must be received by 8 September. **www.cibse.org/symposium**

Feedback sought

CIBSE and the CHPA are seeking feedback on the draft of the new joint publication *Heat networks: a code of practice for the UK*. For more information visit **www.cibse.org/HeatNetworksCode**

Help inspire the next generation of engineers



- **Promote engineering by becoming a STEM ambassador**

STEM ambassadors use their enthusiasm and commitment to encourage young people to enjoy science, technology, engineering and Maths (STEM) subjects. Pursuing STEM subjects and careers opens the doors to a whole world of opportunities.

STEM ambassadors not only inspire young people, they can support teachers in the classroom by explaining the use of STEM in industry or research.

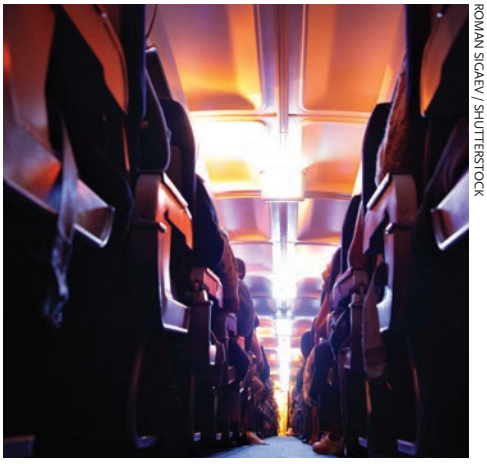
They contribute to their local community and, at the same time, boost their own professional skills, experience and confidence.

If you have an interest in science, technology, engineering and/or mathematics you can register as a STEM ambassador. The most important qualities are to be enthusiastic and a positive role model for STEM subjects and associated careers.

'Often young people cannot comprehend the doors that are opened by STEM subjects but, by showing them how interesting, and influential engineering can be on things like new technology, the environment, buildings and even economic issues, they can see how they can help change the future,' says Carla Bartholemew IEng ACIBSE, mechanical engineer, building engineering, Aecom and STEM ambassador.

If you are interested in becoming a STEM Ambassador visit **www.stemnet.org.uk**

Lighting Research and Technology Journal published



ROMAN SIGAEV / SHUTTERSTOCK

Lighting Research and Technology Journal (LR&T), produced by Sage in association with The Society of Light and Lighting (SLL), publishes research on all aspects of light and lighting.

The latest issue 46(4), features papers considering the topics of daylight, external lighting, human factors and the technical aspects of lighting equipment. This issue also includes the second LR&T Digest, providing a link between lighting research and lighting practice for fields of study, which are considered to have reached a consensus.

The titles of the papers are:

- LR&T Digest 2 Tubular daylight guidance systems
- A framework for predicting the non-visual effects of daylight – Part II: The simulation model
- Comparison of electronic and conventional ballasts used in roadway lighting
- Subjective evaluation of luminance distribution for intelligent outdoor lighting
- Optimal radiant flux selection for multi-channel light-emitting diodes for spectrum-turnable lighting
- Life-cycle assessment of a fluorescent lamp luminaire used in industry – a case study
- The influence of coloured light in the aircraft cabin on passenger thermal comfort
- Light adaptation in letter contrast sensitivity: The influence of optical and neural mechanisms.

The LR&T Digest can be accessed for free at **http://lrt.sagepub.com**

SLL members can read LR&T Journal for free at **www.cibse.org**

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Air conditioning and heating solutions

New PDTs launched at CIBSE BIM site

Eight product data templates now available for consultation

Eight product data templates (PDTs) are now ready for public consultation at CIBSE's dedicated BIM site.

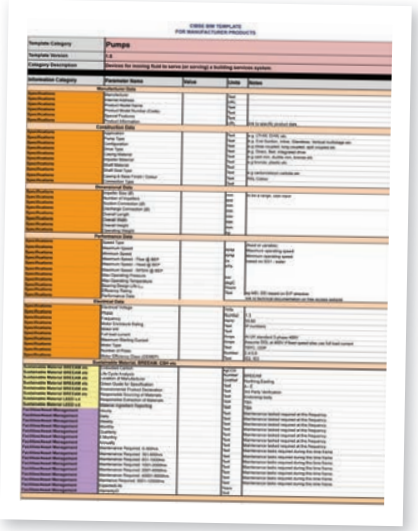
The PDTs of the following products are available: radiators; luminaires; pumps; air diffusers; heat detectors; pumps; manholes and isolation valves.

PDTs, produced by CIBSE BIM Steering Group and CIBSE, can be used to guide the creation of specific product data. Manufacturers and suppliers can then use the templates to provide detailed product information in this standard format.

Building Information Modelling (BIM) users need product data, with many already demanding it from manufacturers. This will be essential information when BIM level 2 comes in, in 2016.

PDTs are standard product 'questionnaires', one for each equipment type, that manufacturers complete once for each of their products. Each PDT aims to anticipate the information sought by every party – from specification through operations to decommissioning and replacement. Written in simple Excel format, PDTs are usable with all BIM platforms, avoiding the need to grapple with multiple platforms.

The PDT asks only for general product information that applies in any application. It doesn't contain application-specific parameters (such as duty point criteria, cost, delivery, placement, an so on). Obtaining this project-specific data remains a normal quotation process.



When a manufacturer completes a PDT it becomes a Product Data Schedule (PDS) – a 'digital' description of the product. Subject to respecting the PDT's terms of use, the manufacturer owns the PDS, is free to use it, and is responsible for its accuracy.

Developing PDTs

Producing the PDTs requires industry-wide collaboration and CIBSE needs your help. We are looking for authors to help support PDTs, particularly manufacturers and trade associations. The full list of product types that will be needed is available on the CIBSE website.

If you would like to comment on these draft PDTs or be involved in developing templates, please email **pdt@cibse.org**

New PDTs are continually being made available for consultation – for latest updates follow **@CIBSE_BIM** on Twitter. For more information on PDTs, visit **www.cibse.org/bim**

Paddy Conaghan, chair of the CIBSE BIM Group, will be presenting on PDTs at the CIBSE Conference on 28 October. For more information, visit **www.cibse.org/conference**

Farewell Jack Pirie (1939-2014)

By Peter Kinsella, CIBSE President 2014-2015

It is with great sadness that we report the death of CIBSE stalwart Jack Pirie MCIBSE.

Jack had a long career in the building services industry, and was a student and lecturer at the National College for Heating, Ventilating, Refrigeration and Fan Engineering in London, before founding, managing and chairing Fantech, Australia and New Zealand's largest fan and ancillaries group.

Jack was an active CIBSE member for more than 50 years. He was involved with the ANZ Region, serving on the committee for six years and as ANZ chair from 2001 to 2003, and said that he gained a huge amount from his involvement with CIBSE. In recognition of his commitment, Jack was awarded CIBSE's Bronze Medal and was inducted into the ARBS Hall of Fame.

These achievements pale against the overpowering memories of Jack: he was an extremely warm, pragmatic, humble and generous man, who prided himself on never being too afraid to take a chance. Jack remained involved with many projects and will be missed by a much wider range of people than the CIBSE family and building services industry.

New agencies admitted to Washington Accord

The Washington Accord, signed in 1989, is an international agreement among bodies that accredit engineering degree programmes.

It recognises the substantial equivalency of programmes accredited by those bodies and recommends that graduates of programmes accredited by any of the signatory bodies be recognised as having met the academic requirements for entry to the practice of engineering.

For CIBSE this means that programmes under the Washington Accord will meet the academic requirements to become a Chartered Engineer.

Following a meeting of the International Engineering Alliance in June 2014 in New Zealand, the Washington Accord has admitted a further two accrediting agencies: The Institution of Engineers, Sri Lanka and the National Board of Accreditation, India.

In the case of the National Board of Accreditation (NBA), recognition of programmes by other signatories applies only to NBA-accredited programmes, offered by education providers that are accepted by NBA as Tier 1 institutions.

For The Institution of Engineers, Sri Lanka, recognition applies to students graduating from IESL accredited programmes after 13 June 2014.

Individuals looking to gain CIBSE Membership and Professional Registration for CEng, where their qualifications are accredited under the Washington Accord, can follow the standard route once they have demonstrated their competence at this level.

Full details on changes to the Washington Accord can be found at **www.ieagreements.org** and for more on gaining MCIBSE CEng, visit **www.cibse.org/member**

Speakers revealed for CIBSE leadership conference

- **Speakers at the Building Performance Conference & Exhibition on 28-29 October 2014 include industry big hitters**

Major speakers have been confirmed for CIBSE's first Leadership in Building Performance Conference & Exhibition.

The speaker line-up includes experts and leaders from across the building services industry, including Sainsbury's head engineer Mark Hawker, RIBA president Stephen Hodder, and the new president of B&ES – and head of design at Crown House Technologies – Andy Sneyd CEng FCIBSE.

The event takes place in London, on 28 and 29 October 2014, at the Queen Elizabeth II Conference Centre.

The programme will feature high-level debates on government policy, and discussions on key design and operational issues, such as soft landings, BIM and overheating.

Highlights include CAD manager from Arup, Carl Collins, speaking on BIM and decentralised energy project officer at London Borough of Islington, Huw Blackwell, discussing how they delivered the award-winning Bunhill Energy Centre and district-wide heat network.

Other speakers include Hoare Lea consultant Paddy Conaghan CEng FCIBSE, Inking partner Claire Das Bhaumik CEng FCIBSE, and Kerry Mashford, chief executive at the National Energy Foundation.

The exhibition at Leadership in Building Performance covers the facilities life-cycle – from design and specification, through construction, to maintenance and management. Exhibitors include Hoare Lea, Hamworthy, Eastman, Daikin, Condair, IES, Lochinvar, Remeha Commercial, Rinnai, Schneider Electric, Bosch, Baxi Commercial and TMI Lighting.

The shortlist for the Building Performance Awards 2015 will also be revealed at a drinks reception at the end of the first day of the conference.

Conference partners include the British Property Federation, Association for Consultancy and Engineering, and the UK District Heating Association.

To book your place visit **www.cibse.org/conference** Early bird rates are available until 15 September.

The Queen Elizabeth II Conference Centre in Westminster

Andy Sneyd

Kerry Mashford

Stephen Hodder

Paddy Conaghan

Conference programme

Day 1 – Tuesday 28 October 2014

- Future of power networks and supply
- Towards real zero
- Delivering future construction through collaboration and BIM
- Soft landings, and maintaining and managing our buildings
- Announcement of shortlist for the 2015 Building Performance Awards.

Day 2 – Wednesday 29 October 2014

- Delivering comfort – overheating and indoor air quality
- Beyond the code – the Housing Standards Review, the Code for Sustainable Homes, and designing for future homes
- How to deliver Level 2 Building Information Modelling, and the implications for the public sector
- New technologies for improved building performance.

Last chance to enter 2015 Building Performance Awards

The closing date for entries to the 2015 CIBSE Building Performance Awards is 11 September.

The awards seek to reward innovation and best practice in the building services sector.

For 2015 there are two new categories: Lighting for Building Performance and Building Control System. These recognise the importance of building operation and maintenance in reducing energy use in the building estate.

The awards focus on actual, measured performance rather than design intent or performance specifications.

Last year's winners included Gardens by the Bay in Singapore, by Atelier Ten; and Marks & Spencer and Sustainable Design Solutions, which won the Carbon Champion of the Year accolade for M&S's Cheshire Oaks store.

To enter the 2015 awards, visit **www.cibse.org/bpa** The same site features a full list of 2014 winners.

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- Energy Saving Product
- Lighting for Building Performance NEW
- Energy Management
- New Build Project (value up to £10m)
- New Build Project (value over £10m)
- Refurbishment Project (value up to £5m)
- Refurbishment Project (value over £5m)
- International Project

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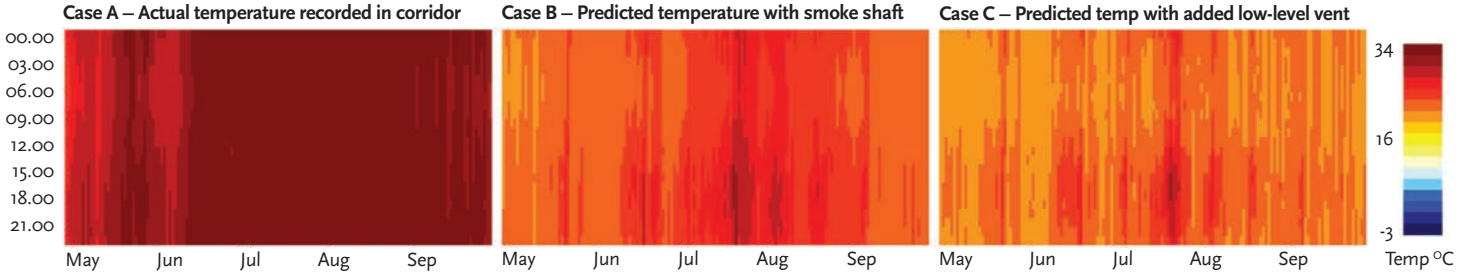
Feedback

Readers respond to Liza Young's article on overheating in last month's *Journal*



Colour maps represent every hour of the year as a coloured block, with the hour of each day running from 00:00 to 23:00, top to bottom, and day of year running from left to right. This helps to identify the times of the year when the overheating risk is greatest

Venting hot air

Paul Compton highlights a topical problem in overheating corridors in residential blocks (*CIBSE Journal*, July 2014). He is correct that improvements to reduce winter heat loss have resulted in the unintended consequence of overheating corridors, which is compounded by communal hot-water pipework being routed through circulation space ceiling voids – although this is good practice for maintenance regimes. At SE Controls, we have modelled several buildings using dynamic thermal modelling to assess the risk of overheating corridors. Without any intervention, the risk of overheating is very high, with predicted temperatures exceeding 35°C, for long periods of time, a common outcome.

Natural air flows through these spaces can be provided via smoke shafts and stairwells, and bi-directional flows can mitigate overheating risks. Our studies often show that additional low-level vents also help to promote airflow, and further reduce the overheating risks to corridors. The ideal scenario is to have internal circulation doors on hold-open devices – though this is subject to building control and the required fire strategy. Designers should also consider the amount of glazing in stairwells, because solar gains are often the greatest contributor to heat accumulation in these areas.

We produce colour maps of a whole design year as modelled – representing the temperature of each hour as a coloured block (see diagram above). The example (above) shows a corridor that is overheating (Case A) and the predicted temperatures after using a smoke shaft to vent hot air (Case B), and adding additional low-level vent (Case C). [See the full diagram on the *CIBSE Journal* app].

Chris Iddon, design manager, SE Controls

> The air remains immovable, displaying a resolve of which Winston would be proud

Tickled pink

Thank you for your excellent article, in August's *CIBSE Journal*, drawing attention to overheating in modern dwellings. Having relocated from New Zealand to Milton Keynes – and sweltered through two months of a UK summer no-one told us was possible – my wife and I are simply waiting for the agony to end.

Our flat is five years old, single-bedroom, single-aspect (south west), EPC rating B, no shading, floor-to-ceiling glazing. Arriving in January, and knowing only what we'd been told of the UK seasons, we promptly opted for the most heavily fleeced flat we

could find, and enjoyed a mild winter – we used the central heating once, to test if it worked! An inefficient fridge/freezer and oven-cooked dinners warmed the flat through the night. We were tickled pink… if only we'd known what was coming!

For two months, we have left windows open during the day while at work – risking (admittedly acrobatic) burglary – and thrown open the balcony door in the evening, with a fan sat square and centre, firing on all cylinders until bedtime. To no avail… the air remains immoveable, displaying a spirit of resolve of which Winston would be proud. Windows close at bedtime, to defend against hearing loss induced by Tesco's 18-wheelers caterwauling along Watling Street – we haven't had a sheet on the bed since May. We eat salads and cook small portions to minimise heat gain from appliances, and I'm thankful the lighting is low-wattage LED rather than heat-lamp halogen. Clothing consistently breaches broadcasting standards; there are 'killer views' all right… from the other side of that floor-to-ceiling glazing! I'm now baffled that my mindset had been so one-dimensional towards thermal performance. There is no way we would rent a sweatbox with these qualities again.

I now dread awakening to blue skies, and we're counting down the days to winter. I still find that hard to believe… no-one I speak to Down Under does. Your columnist is right – when it comes to natural ventilation, the 'art has been lost'… as has the meaning of 'opening the window' in modern apartment living.

Ben Cullen, lighting engineer, Opus International Consultants (UK)

On CIBSE's LinkedIn group, users discuss the potential of 3D printing in building services

Angela Malynn

A team at Cornell University in America, has developed interlocking ceramic bricks that are lightweight and need no mortar. Technology driving change – but what are the consequences?

Simon Owen

This is big. Looking at the wider aspects, it becomes huge: potential transport savings without having to shift material; water- and carbon-use reduction, coupled with shorter build times. Will we still need skilled personnel to put them together? What is the impact for the thermal, acoustic and fire properties of the fabric?

Tony Johnstone

Wouldn't it be better to forget bricks altogether? Why not get the 3D printer to put together the optimal component for today's machine-handling environment. Whole houses might be over ambitious – but bay-size panels? Factory-tested and shrink wrapped for JIT delivery? An obvious extension of BIM design.

● Read about 3D printing in our article on page 40.

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.

WE ARE IN A GOOD PLACE

*Ruskin's **David Fitzpatrick** is delighted that firms are doing so much to recruit and develop young engineers – they'll be needed in a rising market*

Pragmatism – it is a great British character trait. We like to keep our feet on the ground – and as for boasting about business success, forget it. We Brits just don't do that.

However, sometimes it is important to acknowledge when things are going well and give credit where it is due.

The construction industry is expected to grow by 22% over the next five years, according to figures from the Construction Products Association. Output will grow by 4.7% this year and by 4.8% in 2015. We are expected to get back to pre-recession peak growth levels by 2017.

> Cash flow becomes a key concern when activity picks up

So business is picking up, and the employment situation is also improving. Last month, I chaired the judging panel for the CIBSE Employer of the Year Awards, and was delighted by the many things companies are doing to recruit, retain and develop young engineers. We are also blessed with another bumper crop of top-quality finalists in this year's CIBSE ASHRAE Graduate of the Year Award – you can see the evidence for yourself if you attend the CIBSE Young Engineers' Awards on 9 October (the shortlist is announced on page 9).

It is a perennial complaint that British firms do not invest properly in developing engineers, preferring instead to 'poach' from each other. The evidence put before the awards judges shows that this problem is no longer as widespread as it was. Many more employers are 'growing their own', and have long-term, innovative programmes in place to provide clear career progression for their young engineers – not because they are charitable institutions, but because it makes business sense.

Having said that, there is still much to do. A good starting point will be to cherry-pick some of the best ideas from the employer award winners and share these with the industry at large, to help tackle the skills deficit that threatens an otherwise promising economic picture.

We are not out of the woods yet. Such dynamic growth brings its own pressures – cash flow, in particular, becomes a key concern when activity picks up, along with rising material and labour costs. Profit margins remain tight, and we need to stick to the prudent business approaches we adopted during the lean years.

Most importantly, we will not deliver quality projects in the rising market unless we have enough skilled engineers. So keep up the good work – and keep the faith in young engineers.

Ruskin Air Management is a market leader in air distribution, and fire and smoke control. It combines the Actionair, Air Diffusion and Naco brands. The companies work together to provide complete HVAC solutions for the built environment.

WHY ESOS WILL BOLSTER AIR CONDITIONING INSPECTIONS

ESOS is coming soon, along with the rules for F-Gas phase out. Those meeting requirements for air conditioning inspections may be at an advantage in dealing with both. **Hywel Davies** explains

Since 2009 the Energy Performance of Buildings Regulations has required five-yearly inspections of large air conditioning systems. The inspection report should include recommendations of potential cost-effective improvements to the system. This requirement was extended in 2011 to include all systems over 12kW rated output.

At the time the regulations were introduced, the impact assessment suggested that while there was considerable uncertainty about the number of systems within the scope of the requirement, at a very conservative estimate there are 300,000 such systems in use, and quite possibly many more.

The object of the regulations was to make their owners or operators aware of how effectively they were being maintained and operated, and what scope there is to reduce the costs through better system management.

For the past two years it has been a further requirement to lodge air conditioning inspection reports. Based on the data provided by Landmark, the register operator, some 1,000 reports are lodged every month. That is 12,000 a year, or 60,000 every five years, strongly suggesting that compliance with this requirement is limited to no more than 20% of systems.

However, those that have undertaken the inspections will be at an advantage on two counts. First, they will be fully aware of those systems which contain refrigerants that are due to be phased out from 1st January 2015. Under the rules of the F-gas Directive it will no longer be permitted to service, maintain or recharge these systems. So while it will not be illegal to operate them, their owners need to be aware that the refrigerant system cannot be maintained or replenished, so that should they fail in any way then they will have to have the remaining refrigerant removed and disposed of correctly.

KELLY MARKEN / SHUTTERSTOCK

CIBSE members who cover air conditioning should prepare for a busy period

> This also raises an interesting question for those cases where there should be an air conditioning inspection report, but it is missing

Either an alternative refrigerant will have to be used, or the system will have to be replaced.

Arguably, any system that is still using these refrigerants will be old. It will be less efficient than any system currently on the market, as efficiency standards for air conditioning have driven a steady improvement in standards.

Anyone with an air conditioning inspection report should have been made aware of the type of refrigerant in their system, and also been advised about the potential savings from replacement with a newer system.

Where they have a refrigerant that cannot be maintained beyond 2014 then this and the options for dealing with it should have been explicitly addressed. This should assist the operators in planning to deal correctly with any old systems.

Current air conditioning inspection reports can also help with the forthcoming Energy Savings Opportunity Scheme (ESOS). This will require large organisations to undertake an energy audit covering buildings, transport and industrial energy use.

One characteristic of the scheme is that lead assessors have discretion to determine how to carry out the audit, and to take account of existing information about energy use in the organisation. They also have to provide an assessment of cost-effective improvement measures for the organisation. Clearly, where there are already air conditioning inspection reports, these will contain specific recommendations relating to the systems inspected and can therefore be incorporated into the ESOS audit.

This also raises an interesting question for those cases where there should be an air conditioning inspection report, but it is missing. The ESOS assessor will have a duty to report this non compliance with the Energy Performance of Buildings Regulations. The cost-effective remedy for this omission must surely be to commission a report – and it would make sense to commission it as part of the ESOS assessment, so that its recommendations can be incorporated into the ESOS report as well. Given that the ESOS assessment report must be signed off by a director of the organisation, it will be interesting to see how this is handled.

There is a further incentive for larger organisations to address this topic. Government has just consulted on proposals to limit the sale or rent of properties which have F and G rated EPCs. One way to address this in older air conditioned properties is to improve the air conditioning system. It may not solve the problem, but will make a contribution.

Meanwhile, any organisation, large or small, that is running a system with R22 or similar refrigerant, which has not got a plan for what to do after 1 January 2015, also needs to decide what the next steps are for tackling this issue.

CIBSE members who are active in the air conditioning industry, including our air conditioning inspectors, may find there is quite a bit to be done in the coming months.

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

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THE VALUE PROPOSITION

Engineers should be excited by the Energy Act 2011 because it has the potential to embed their work in property valuation – a key driver for the commercial property retrofit market, says **Andrew Cooper**

Until recently, many asset managers regarded building services as merely an operational function of a building. Whether services worked efficiently or not was often irrelevant, because operational and energy costs were passed on to tenants through service charges or direct billing/recharging. These costs do not form part of valuation calculations, so it is difficult to work out a value differential between an efficient building and a less efficient one. The incentive to make buildings more energy-saving has been stymied by valuation techniques and the way the UK leasing market operates.

However, there has been a seismic change in fund and asset management strategy within the larger UK property funds and real estate investment trusts (REITs). Managers are beginning to take energy efficiency very seriously – in particular, a building's energy performance certificate (EPC).

This is largely a result of the Energy Act 2011, and its requirement for minimum energy efficiency standards – known in the property market as MEPs (minimum energy performance standards) – which are tied to a building's EPC. In July this year, the government released its consultation on the implementation of the legislation and its energy efficiency regulations of the non-domestic private rented sector in England and Wales. The consultation has reaffirmed the likelihood of an MEPs threshold of an E-rated EPC.

The proposal is that rental properties that require an EPC under the EU Energy Performance of Buildings Directive will also be subject to MEPs. From 1 April 2018, all new lettings would be subject to minimum standards, and – from 1 April 2023 – a regulatory backstop would apply, meaning all let properties must comply with legislation.

The Act introduces a mechanism for identifying qualifying energy conservation measures – known as the Golden Rule – and mandates their installation. The Golden Rule is that repayments for improvements, including any interest charges, must be the same or less than the expected energy bill savings in the first year.

Properties rated F or G that are captured by the legislation will need to undergo a due process linked to this rule. If, afterwards, they remain F or G rated, only then may they be let.

> The Energy Act 2011 introduces a market dynamic with the potential to affect value and/or the amount of finance secured against an asset

If a property cannot be let, rental income will be lost until it is compliant. Because of the way rent reviews and lease renewals operate, there is also a risk of reduced rent if an E+ rated EPC is the result of an occupier's fit out, rather than the landlords'. The Energy Act 2011, therefore, introduces a market dynamic with the potential to affect value and/or the amount of finance secured against an asset – be this directly, or indirectly through utility bills.

There is already evidence of transactions being affected by EPC ratings at the fund and REIT level. If this continues, and is replicated across the market, a clear value differential based on comparable evidence – a central tenet of UK valuation techniques – is likely to emerge.

There are concerns over the proposals – particularly the link to the Green Deal, and the fact that Green Deal Finance is not yet available for non-domestic properties. But the consultation document provides investors with a degree of certainty that an investment in energy efficiency is a priority.

Such sentiment is supported by Deloitte Real Estate's research document *Carbon Penalties and Incentives*, commissioned by the Green Property Alliance and the Green Construction Board. Miles Keeping, a partner at Deloitte Real Estate, says investors welcome moves to create certainty in the marketplace because it enables them to plan risk management. 'Investors want to see a sensible and robust framework for the managed reduction of carbon emissions,' he said.

The potential rewards for the UK economy are enormous. Research by CO_2 Estates estimates the cost of improvement works to F, G and the worst-performing E-rated properties to be £29bn, resulting in an estimated £3.9bn per year reduction in running costs – and at the heart of all of this will be the building services engineer.

ANDREW COOPER is an independent commercial property and energy consultant

QQ7 / SHUTTERSTOCK

INVESTMENT POTENTIAL

COST OF IMPROVING EPC E+ RATED BUILDINGS: £29BN

ANNUAL REDUCTION IN RUNNING COSTS: £3.9BN

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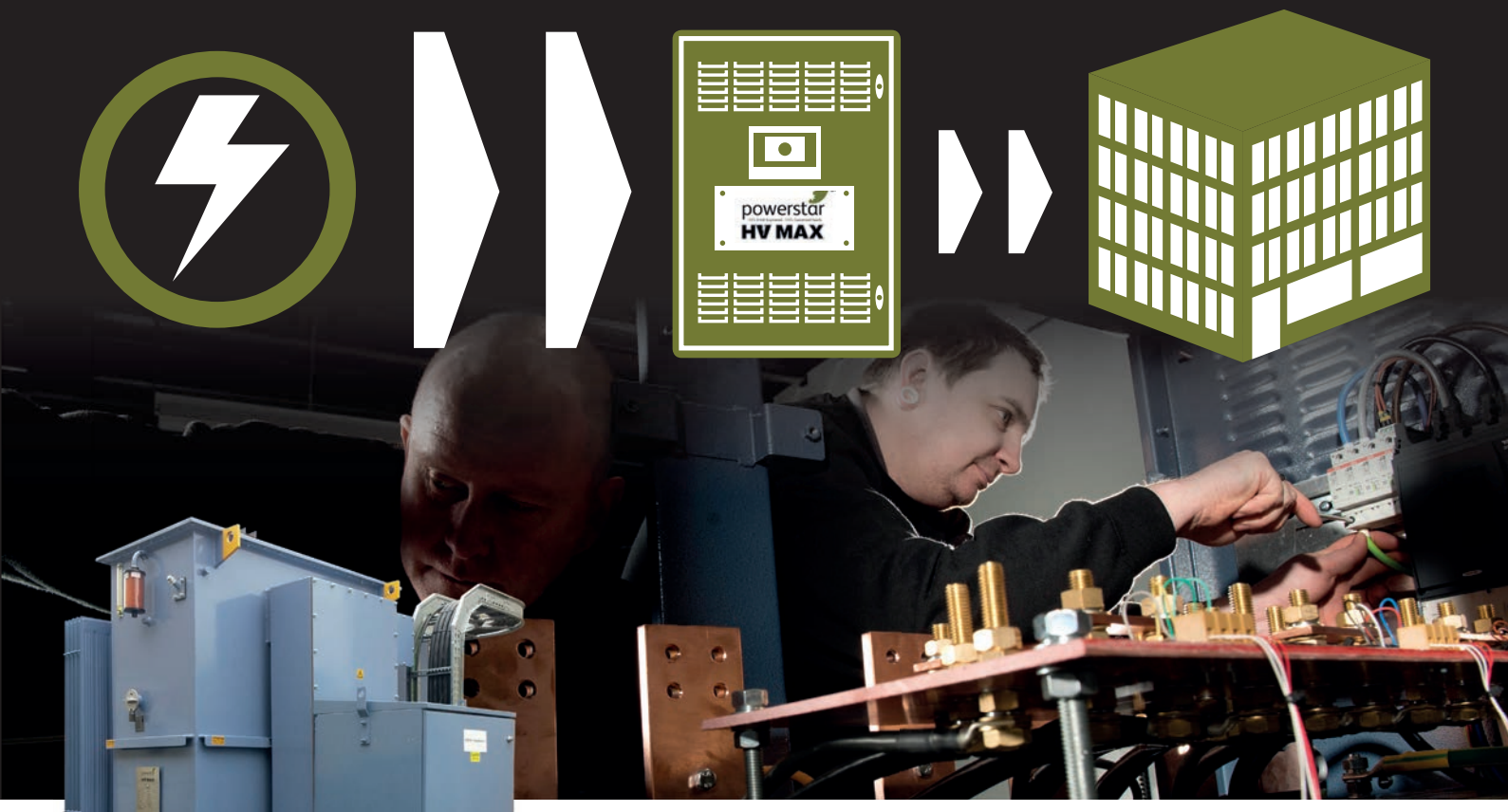

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THE RECRUITMENT SEE-SAW

A new report reveals that 20% of firms are unable to bid for work because of staff shortages. **Simon Owen** says the industry has to change its attitude to avoid losing another generation of engineers

You have a large pile of tenders, a busy order book and regular enquiries from clients; business is booming and the sun is finally shining. Industry reports back up your instinct – the National Specialist Subcontractors Council (NSSC) published the results of their quarterly survey in August, which identified 43% of respondents are working to 90% of their capacity, while 72% of respondents expect to be busier next year than they are now.

Unfortunately the rising sun casts a shadow; that same report identified that 20% of respondents are deterred from bidding for new work by staff shortages.

Go back to 2008 before the big crash, when industry was at its peak. We were all working flat out and there was a feeling that it was almost better to have someone rather than no-one in a seat – you could work around their limitations. Staff structures were hard to maintain because there were no engineers to recruit and existing staff were looking for promotion, pushing up salaries.

Employers talked of being haunted by ghosts of the last construction recession. The perceived lack of job stability and low salaries, compared to other industries, made engineering unappealing for new starters. Those recruiting complained of competitors having low training standards and everyone was acutely aware that engineers were generally an ageing population. There was a gap between requirements and availability on both sides – employees didn't just want a job and salary increase, while employers sought more than a bum on a seat.

Never has the phrase 'crash' better described a recession; its impact was immediate and industry was woefully unprepared. Short-term survival and cost focus was the order of the day. Some firms slashed headcount while others cut salaries and reduced hours in an attempt to retain their skill base. Some opportunistic firms tried to gain a commercial advantage by poaching top talent from industry rivals.

Graduate placements, work experience and apprenticeships became hard to come by for those completing their education, while training opportunities were cut overnight.

People were forced into career changing moves; those in need of experience went to work in other industries or returned to education, while those at the other end of their careers set up on their own, worked below their level or simply retired. There was a skills drain to the south and abroad, while those left became jaded by the unending cycle of bad news and the sense their careers were stagnating.

> Some organisations slashed their headcount while others implemented salary cuts and reduced hours in an attempt to retain their skill base

Hindsight is a wonderful thing, but what if calmer heads had prevailed? Imagine if those solvent companies made 10% shallower cuts and 10% more investment than they did?

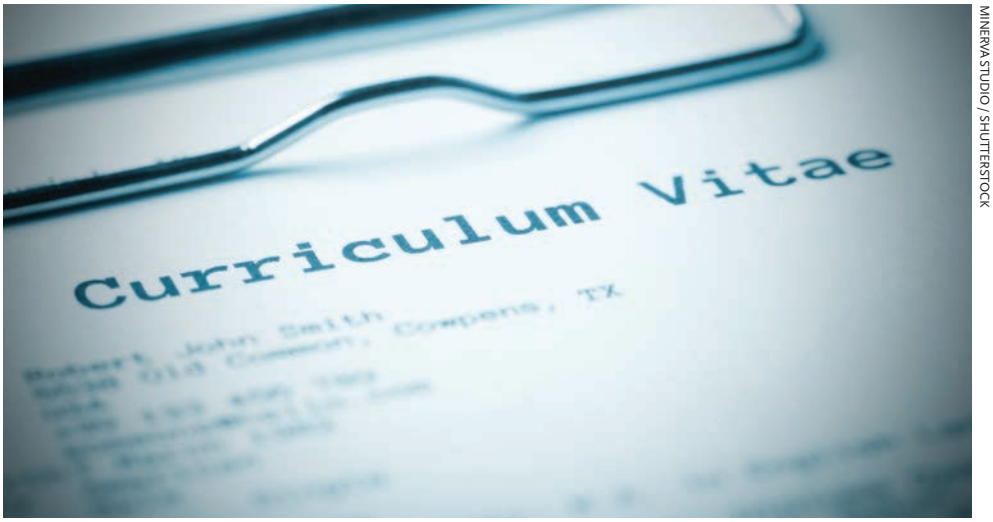
Undoubtedly shareholder value – and director and partner incomes – would have been reduced, but our present skills crisis would not be so acute.

The availability of project delivery-level staff would be more in line with work levels, and a stronger pipeline of people coming into industry would be prompted by confidence in post education work availability. Those with skills in new technology, such as Revit, would actually exist and fewer people would have been lost to busier, allied sectors such as nuclear and rail. And, generally, morale in the industry would have been much higher.

Construction may have left the days of thin order books, 'cut your own throat' pricing and redundancies behind us, but the current recovery makes us extremely vulnerable to a lack of skills availability. Industry is on a see-saw between boom and bust – between work and skills availability. It must change.

There are some encouraging signs. Wonderful initiatives such as Class of Your Own are gaining traction with support from government, professional bodies and industry, while apprenticeships are experiencing a renaissance and employers are recruiting for attitude as well as skills.

The next few years will undoubtedly be difficult, but without a drive to attract and retain new engineers, future decades will be much, much harder.



MINERVA STUDIO / SHUTTERSTOCK

SIMON OWEN is head of building services, facilities management and energy management/sustainability at Calibre Search

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Engineering DNA

One of the world's largest biomedical research centres is nearing completion in a heavily built-up district of central London. Arup's **Steve Berry** unravels the secrets of the Francis Crick Institute

In 1953, Francis Crick – together with his colleagues James Watson and Maurice Wilkins – identified the structure of DNA. This proved to be of significant importance to biomedical research, and earned Crick, Watson and Wilkins the 1962 Nobel Prize in Physiology or Medicine.

In 2015, the institute that bears his name will open its doors to the scientific community. Located opposite London's St Pancras Station it will be an entirely new organisation, with a distinctive vision of how medical research should be conducted. This involves bringing the best minds together and engaging in extensive collaboration between scientists, biologists, chemists and physicists, with the aim of discovering treatments and cures for human diseases and ailments.

The Francis Crick Institute, when completed, will be one of the largest biomedical research facilities in Europe. It is a unique partnership between Cancer Research UK, the Medical Research Council, the Wellcome Trust, University College London (UCL), Imperial College London and King's College London.

As the client's consultant, Arup was involved in the evaluation of various sites before settling on the institute's final location in 2008. The firm was appointed – after a competitive tendering process – to carry out the MEP engineering design, project management, fire, security and logistics consultancy services.

The 82,000m^2 facility – which will house 1,500 scientists and support staff – consists of four basement levels, including two interstitial plant floors, and eight levels above ground, which will contain laboratory, plant, support, administration and amenity areas. The building is made up of two bars – north and south – which are connected by an east-west atrium. The bars are further divided by a north-south atrium extending across the building.

The location was carefully evaluated, placing the institute within a cluster of

Southern façade showing roof PV panels

PROJECT TEAM

- **Client** – Francis Crick (UKCMRI)
- **Project manager** – Arup Project Management
- **Architects** – HoK/PLP and BMJ
- **MEP engineer** – Arup
- **Cost consultant** – Turner and Townsend
- **Structural engineer** – AKT
- **Main contractor** – Laing O'Rourke

Aerial view of north and west façades

IMAGE: LAING O'ROURKE R.PAINE

KEY DATA

- 15 MVA electrical supply capacity
- 7.5 MVA standby generation capacity
- 2 MVA CHP plant
- 300,000 litres diesel fuel storage
- 4 x 4,000 kW water-cooled chillers
- 3 x 6,500 kW steam boilers
- 3 x 3,100 kW LTHW
- 1 MW data centre
- 13 passenger lifts
- 9 goods lifts
- 4 x 3,250 kg liquid carbon dioxide/ liquid nitrogen tanks

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hospitals, educational institutions and learned societies, which are already working on some of today's most important medical research.

The project was conceived as a multidisciplinary, life-science research facility, incorporating primary and secondary shared/dedicated laboratory areas, plus associated write-up areas, biological research facilities (BRF) – with high-containment laboratories alongside chemistry and dry-lab functions – together with all the required amenity, administration, auditorium, restaurant and support functions. Each of these elements presents its own particular engineering and design requirements.

The site is landlocked, with the British Library to the south, St Pancras Station to the east, and listed housing blocks to the north and west. Below ground, the surrounding streets are crowded with utilities, including two 120-year-old, low-pressure gas mains.

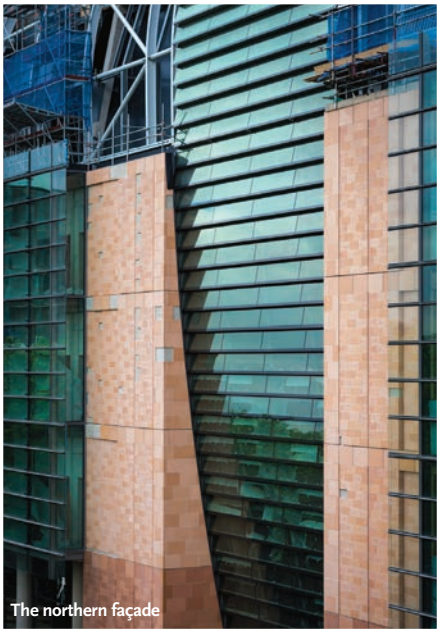
The area is densely populated and there are two tube lines running underground, close to the site. The subterranean St Pancras Box –which incorporates the St Pancras International domestic rail station – is adjacent to the site, on the east side.

Modern laboratory buildings can only accept extremely low levels of vibration transmitted within the building structure, so the project adopted a blanket level of Vibration Criteria-A (VC-A) across all laboratory floors, with local isolation tables in areas – such as the imaging zone – that required more stringent VC-D/E. All MEP plant and equipment that generates vibration must be fully isolated from the structure by means of anti-vibration mountings, spring hangers and supports.

The sophisticated research equipment is very sensitive to electromagnetic emissions, which required the MEP equipment to be separated from any receivers by sufficient distances to eliminate interference. The most sensitive equipment has a further level of protection, with both passive and active shielding provided.

Some research has to be conducted in laboratories with high containment levels – CL3 and CL3+ (the highest level). These are subject to stringent security checks by the Health and Safety Executive and must pass rigorous design reviews, called Hazop analyses, as well as qualitative risk assessment (QRA) for the CL3+ lab. This leads to an array of system-component redundancy, and segregated/dedicated plant.

The BRF, while not high-containment, is also subject to considerable scrutiny by the Home Office and the Department for Environment, Food and Rural Affairs (Defra).



The northern façade

Exhaust stacks

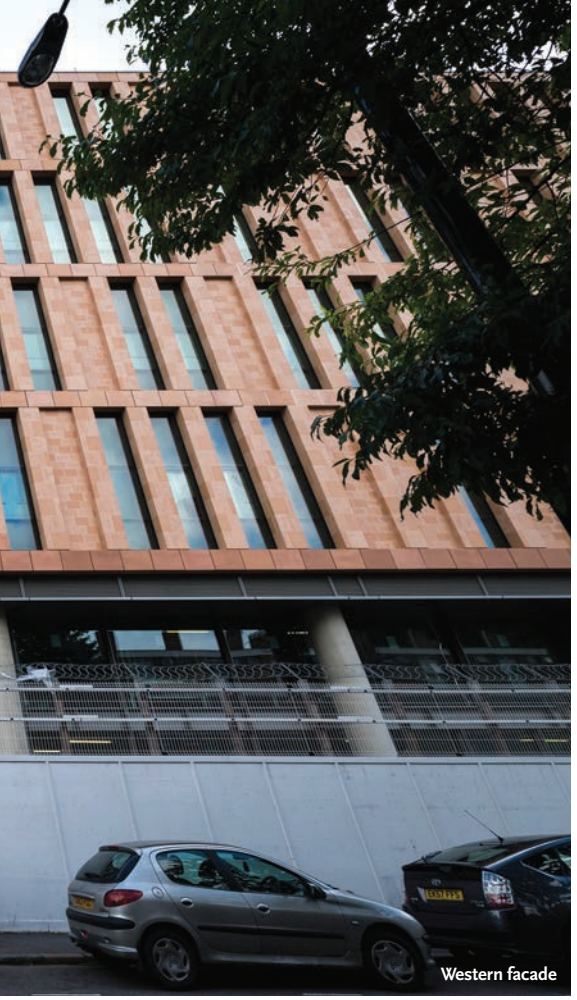
Very high levels of ventilation are required with 20 air changes per hour. The project also has sophisticated diurnal lighting control, acoustic control and high-efficiency particulate arrestance (HEPA) filtration of the air supplies and exhaust. The BRF also incorporates stringent odour control, which is dealt with primarily by careful architectural design, coupled with ventilation regimes.

Emissions from air stacks carrying exhaust from laboratory fume cupboards, the BRF and the high-containment laboratories – as well as the flue discharges from gas-/oil-fired boilers and combined heat and power (CHP) generators – have been numerically modelled by the project environmental consultant.

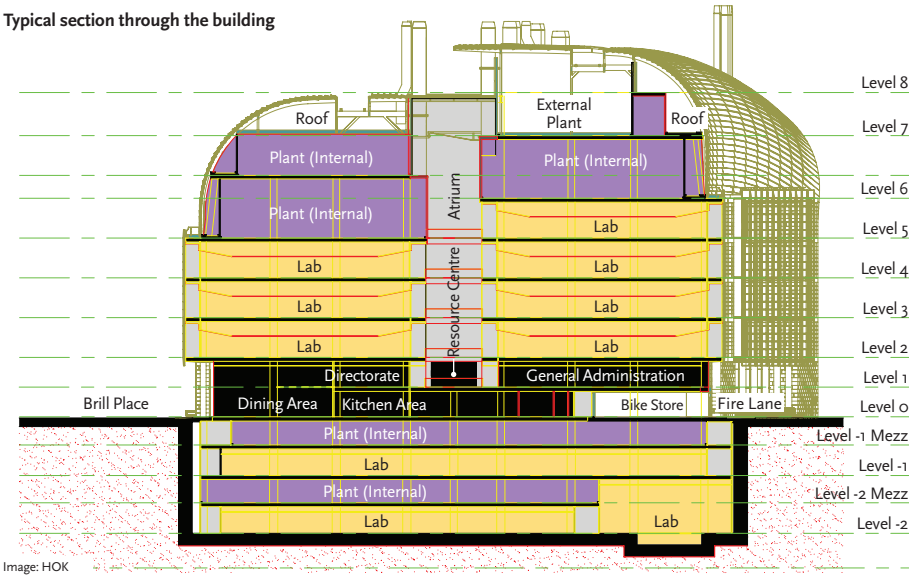
Discharges must satisfy both the Clean Air Act and the local authority with regard to contamination levels at local street-level receptor points. To ensure no discharges are returned into the building, a physical model was tested in a wind tunnel.

To assess the nature and implications of the many engineering challenges facing the project, a number of studies were undertaken by the engineers and other specialists. See the 'Engineering research' box for the full list.

The Francis Crick Institute is the first laboratory – and one of the first buildings of any type – to be subject to the latest (2010) energy regulations, which demand an average of approximately 25% reduction in carbon levels. This was achieved, along with an 'Excellent' BREEAM rating.


Western facade

Typical section through the building



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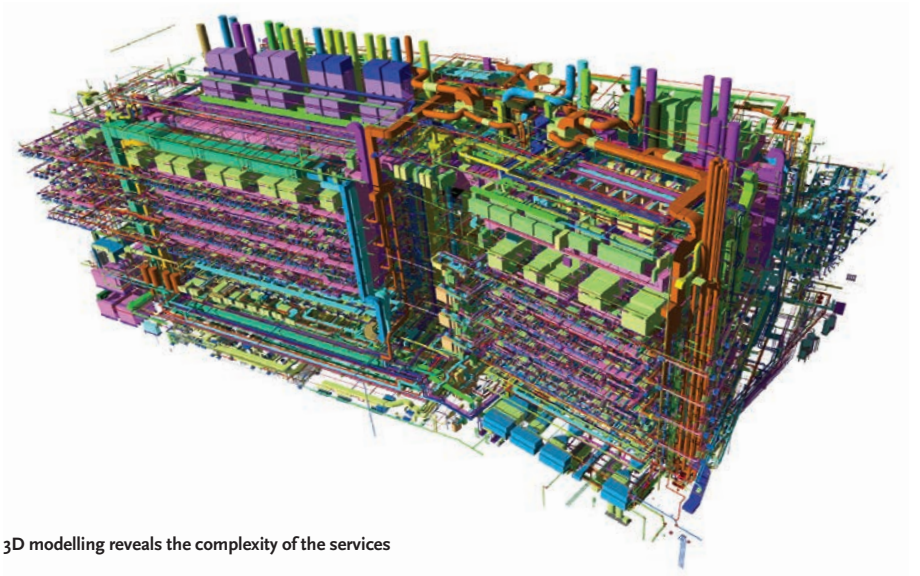


3D modelling reveals the complexity of the services

The sustainable design measures were dictated by the London Plan, as well as Building Regulations. They include shading systems, a 2MVA CHP unit, and 1,700m² of photovoltaics (see 'Sustainable by design' box).

Configuration and architecture

MEP plant and systems have to be functional and adaptable, and fit within the overall architectural form of a building. The brief for the Francis Crick Institute was for it to be aesthetically pleasing, while providing good spatial planning and an efficient working environment. This presented considerable challenges to the architects, because space was constrained and there were stringent planning requirements. The impact of the building's height and massing had to be carefully considered, particularly in relation to nearby housing, which had rights to light.

To a large extent, this drives the MEP servicing strategies. The BRF is all in the 16m deep basement, along with most of the high-containment laboratories. This has meant large interstitial floors are required to accommodate the sizable HVAC and other services required to support these areas.

To restrict and control the potential vibration of the structural-loading impacts of heavy plant, most of this is also located in the basement in its own energy centre.

Air handling equipment requires large fresh air intake, as well as large discharge stacks. (The total fresh air requirement is 430m³/sec – equivalent of emptying an Olympic pool in less than 10 seconds.) For these reasons, the air handling units (AHUs) are on the upper plant floors.

Electrical substations are located at both basement and roof levels, to be close to the main electrical loads.

To distribute services from the plant areas to the occupied floors, large vertical distribution risers were created, running the height of the building. In addition, horizontal primary routes for services connecting between risers at each floor level – as well as providing service feeds to the floor itself – have been created in 1.5m-deep ceiling void spaces.

Laboratory floors

The general laboratory areas consist of primary, shared secondary, dedicated secondary and write-up areas, based on a 6.2m x 9m structural grid, with adaptability built into the MEP design, to allow future changes driven by the science.

SUSTAINABLE BY DESIGN

The project needed to satisfy the London Plan, as well as Part L of the Building Regulations.

The London Plan describes an energy hierarchy:

Be lean – energy efficiency beyond the current Building Regulations

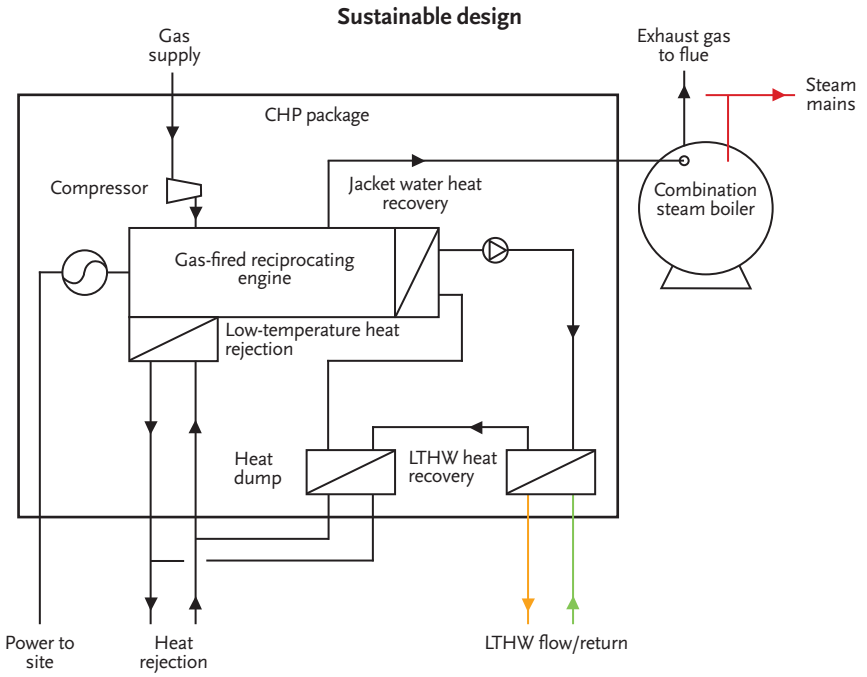
Be clean – priority given to connection to district heating networks and cogeneration

Be green – on-site renewable energy generation.

The following were incorporated into the design to improve energy-efficiency measures: high-performance glazing with shading systems; high-efficiency plant; lighting control and ventilation systems with variable volume flow.

A 2 MVA CHP unit and connections to allow a future integration into a district heating scheme were also incorporated into the design.

In addition, 1,700 m² of solar photovoltaic panels were incorporated into the southern roof façade to generate energy that feeds into the electrical distribution.



The design features a 2 MVA CHP unit and connections to allow integration into a district heating scheme

Ventilation exhaust stacks

Typical laboratory fit-out under construction

> The fresh air requirement is 430m³/sec – the equivalent of emptying an Olympic swimming pool in less than 10 seconds

Primary laboratories are main laboratories, which can accommodate a range of different sciences. Shared secondary laboratories contain high value assets, which are used extensively. Dedicated secondary laboratories are areas containing specific laboratory equipment that is dedicated to a particular area.

The laboratory spaces on the north and south bars are designed to be open, with sight lines between laboratories. They are connected with link bridges and collaboration spaces to facilitate interaction between scientific groups.

The general laboratory areas are designed – from the services point of view – to operate as a Containment Level 2 (CL2) area, with the write-up areas located outside the laboratory. The general laboratory system is a variable air volume (VAV) system, with supply and extract VAV units located within the structural grid. Within secondary laboratory areas, additional fan-coil units supplement the VAV cooling.

Engineering research

A great deal of modelling and analysis was carried out on the Francis Crick Institute before construction began:

- Acoustics and vibration – background acoustics levels and vibration signatures were measured, and then used as the baseline for compliance and mitigation measures
- Electromagnetic compatibility/interference – the profile of the site was assessed in order to establish background levels
- Environmental studies – a number of studies were performed, including the impact the building would have on existing air quality
- Daylighting – studies were performed to identify the impact the building would have on its surroundings, as well as the extent of natural daylight entering the buildings
- Thermal performance – the building was modelled with IES software to confirm compliance with Building Regulations, supporting the BREEAM assessment
- Dispersion modelling – numerical analysis to confirm that the 32 large extract air stacks and thermal flues are compliant with emissions requirements. In addition, wind-tunnel testing done to confirm emissions would not re-enter the fresh air intakes
- Odour modelling – conducted using both numerical and empirical testing of BRF waste and feed materials on exhaust streams. Objective and subjective measures were used to access potential mitigation
- Flooding impacts – assessed based on risk analysis and flood maps
- Computation fluid dynamics – the heat flux in the data centre was assessed under both normal and equipment-failure scenarios
- Lift traffic analysis – Elevate software was used to assess the number, size and location of the lifts.

Modular construction

The main contractor, Laing O'Rourke, adopted a pre-assembled modular approach to MEP services because of the size and scale of the project, and because of the constrained site and challenging construction programme.

In addition to the 4,000-plus pre-assembled MEP modules, a further 2,000-plus prefabricated sections of pipework, containment and valve assemblies have been used in the construction of the MEP systems.

This is in addition to the hundreds of thousands of other MEP products, and devices that have needed to be procured, delivered and installed on a 'just in time' basis.

A separate article on modularisation and off-site assembly is planned for a future issue.

Francis Crick was noted for his intelligence, openness to new ideas, and collaborations with different disciplines, and all of these qualities were needed by the engineering design team to deliver this groundbreaking project. **CJ**

STEVE BERRY CEng MCIBSE is an associate director at Arup

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Whitehall has benefited from Westminster City Council's Smart Lights initiative

INTELLIGENT LIGHT

Energy-efficient lamps and smart control systems are transforming lighting in our streets. **Liza Young** finds out how 21st-century technology is saving taxpayers millions, and casting cities in a whole new light

> Westminster's streets have even been used as backdrops for films, including *Harry Potter* and *The Fast and the Furious 5*

There are a billion of them in the world – one on virtually every street corner of every city, town and village – and you probably don't give them a second glance. But the humble lamppost's time has come.

New technology is transforming street lighting. Intelligent controls and energy-efficient lamps are helping to slash energy bills, and local authorities all over the world are now exploring the potential benefits of high-tech lighting.

Westminster City Council is one such authority. It is responsible for around 14,000 lamps and – with an annual electricity bill of nearly £1m – was keen to upgrade its street lighting. The council is currently in the process of replacing its tired stock with energy-efficient lamps that incorporate intelligent controls to produce the right light, in the right place, at the right time.

What's more, this new technology has given Westminster the opportunity to use its urban lighting as a creative backdrop to Londoners' lives – particularly where LEDs have been installed. From a remote location, designers can change the colour and brightness of individual lamps to transform streets into real-life film sets.

Smart lights

Westminster's Smart Lights initiative – launched in 2008 – aims to reduce electricity use by 20% through the installation of energy-efficient luminaires and a central management system (CMS) that allows remote control and monitoring of individual, or groups of, lights.

Existing ceramic metal halide CDO-TT+ lamps – that need changing every two years – are being replaced with GE StreetWise lamps, which have the same lumen output and a four-year lifespan.

LED technology, which can be retrofitted into existing lamps, is also being trialled, providing the potential for further energy savings and coloured mood lighting.

Now in its final year of delivery, the initiative involves fitting dimmable electronic ballasts and communicating nodes into each lantern, which link to a CMS. As part of the LeafNut control system – developed by Harvard Engineering – a leaf-node antenna is attached to the lamps, allowing full remote control and management of lighting levels according to demand.

This could be done daily or weekly – for example, to coincide with theatre opening and

WATCH NOW
See examples of iGuzzini's street and connected lighting at www.cibsejournal.com

LEDs enable more imaginative designs such as the CREE Aeroblade, designed for CREE Lighting by Spiers and Major

Ostfildern, in Germany, converted its mercury-vapour lighting to iGuzzini's LED Wow luminaires

closing times – or monthly or annually, for planned events, such as New Year's Eve and Earth Hour.

Thanks to the adjustable lighting Westminster's streets have even been used as backdrops for films, including *Harry Potter* and *The Fast and the Furious 5*, where street lights in Piccadilly were switched off to coincide with crews' filming schedules.

The solution also provides a daily maintenance report for each light, which not only identifies bulbs that have failed, but is capable of predicting – by monitoring the voltage – which ones are about to fail, so maintenance can be accurately scheduled and managed online.

Currently, street lighting switches on when light levels fall to 70 lux. This allows time for lamps to 'warm up' and reach their required operational output when needed. With modern lamps and electronic control equipment, this process is now much quicker, allowing the 'switch on' to start when light levels fall to 55 lux. Known as 'trimming', this puts back the switch-on time by eight to 10 minutes per street light.

Dynamic lighting

Westminster is also planning to introduce 'dynamic lighting', which allows variable illumination levels to be set based on traffic and pedestrian flow data, as well as crime statistics for different areas. Within British standards, lighting class 'S' ranges from S1 to S6 – with S1 being the brightest level, applicable to areas with high pedestrian or vehicular traffic flows, or where there is a high crime rate.

A street at 10pm could be classed as S3, but – if it's a commute pedestrian cut-through from a railway station at 6pm – it becomes S1, explains Dave Franks, service development manager (public lighting) at Westminster City Council. If there's a pub on the corner, the street may become an S2, and go back down to S3 after the revellers have gone home.

'The biggest problem for authorities is over-lighting,' says Franks. 'Our system takes that wasted light and balances it throughout the whole area. It's about understanding the environment, carrying out risk assessments, and finding a solution that meets that space.' The technologies are in place, he adds, and the council is currently consulting with relevant parties to find the right approach to dimming.

The lights – which can be altered to work at 75% capacity at less busy times – are designed to the British Standard BS 5489-1:2003, or its 2013 equivalent.

Alan Tulla, Society of Light and Lighting past president, says that – by changing the illuminance level, source colour temperature, lantern type and column height – lighting designers can enhance cities and create identities for different regions.

'A common approach for creating identity used to be to floodlight buildings, but this has been somewhat overdone, and the philosophy nowadays is to "light for darkness",' Tulla says. 'A commercial city centre might need a lot of light, whereas the historic quarter may be

BRIEF HISTORY OF STREET LIGHTS

- **1766** First oil-powered street lamps installed in Paris
- **1807** Gas lamps introduced to London
- **1932** Introduction of low pressure sodium (SOX) lamp, characterised by its dull, monochromatic yellow light. Although highly efficient, delivering 160 lm/W, the arc tube is very long
- **1933** Introduction of high-pressure, mercury-vapour (MBF/U) lamps – the first high-intensity discharge (HID) luminaires. The discharge mainly produces UV with a small amount of pale blue visible light. Very inefficient by modern standards, producing around 35-45 lm/W
- **1965** Introduction of the metal halide (MH) lamp – a derivation of the MBF/U lamp. It has a crisp white light with excellent colour rendering, but has poor lumen depreciation
- **1968** First UK installation of high-pressure sodium (SON) lamps in Huddersfield. These were retrofitted into hundreds of thousands of the MBF/U lamp holders
- **2011** UK's first light-emitting diode (LED) street lights introduced in Somerset.

The Piccadilly Circus roll of honour on the Piccadilly Lights for the centenary of the World War I

much better kept in darkness or at very low levels of illumination.

'If you just highlight the important features, the result not only looks better, but also saves a lot of energy.' He adds: 'Light and dark benefit from each other. Without getting too philosophical, if everything is lit, nothing is lit.'

Going global

Cambridgeshire-based integrated system design company, Cyan, provides a communication platform that measures and controls energy consumption for the lighting and metering markets. It has recently dispatched 15,000 smart controls to Aska Technology, in China, for pilot projects.

The CyLux® automated lighting management system works over a self-healing radio network, which allows for continuous connections and reconfiguration around broken or blocked paths. The 'message' from the control server is transmitted along the network by hopping from router to router until it reaches a particular lamp.

Dr Sean Cochrane, technical director at Cyan Technology, says fitting CyLux into new or existing lighting installations using technologies such as high-intensity discharge (HID) lamps with dimming control, increases energy efficiency and lowers average power consumption. However, LED lamps – which allow incremental changes to light intensity – are far easier to control, and don't have reduced life because of frequent switching.

Cochrane says local authorities can make a 30-40% saving by avoiding burning lights at 100% at night. 'It's about making better use of resources. The cost of energy is only going to go up,so we have to make that shift to using more renewables, and making better use of the energy that we have.'

The CyLux system can also override set 'rules', says Cochrane. In parts of the world where a severe storm may be predicted to hit in the middle of the day, lights can be brought up to full intensity, based on the forecast, or by measuring ambient conditions. Aesthetically, he adds, lighting is very personal. 'Someone might regard the orange sodium light as being nicer than LED white light because it's what they're used to, and can be resistant to change.

'If local authorities dim light by 60%, most of the time people don't notice. They want to feel safe, so if you can make changes without disruption – but with energy saving going on in the background – then it's a good solution.'

Connected lighting

Italian lighting company iGuzzini has installed 150,000 LED street light fittings in Europe, and more than 100,000 in Italy. With average annual savings of 230kW per fitting, more than 100GW has been saved in three years – equivalent to the annual consumption of more than 13,000 families.

LED technologies developed by iGuzzini produce white light with a high chromatic yield, which improves visual perception. New optics illuminate the road surface evenly, increasing distances between lighting points and eliminating stray light.

Rohan Servand, marketing specialist at the company, says street and urban lighting needs to be designed. Planned lighting can draw the city's assets together, capitalising on the hierarchy of spaces. He adds that a complete smart-city lighting plan will not only take into account pole-mounted streetlighting, but also architectural lighting, electronic billboard advertising, traffic lights, and direction and emergency lighting.

However, a perfect solution would use 'connected lighting', which incorporates all of the above in an intelligent and responsive manner, says Servand. 'It refers to technology that connects us with light.'

Connected lighting uses motion sensors with algorithms that allow lamps to illuminate to the required intensity when a pedestrian or vehicle approaches, before returning to a lower level.

'Imagine a city where pedestrian and vehicular traffic are not affected by large variations in light levels,' says Servand, 'but where the lighting plan interacts with human movement and needs – and where light levels change gradually and

GLARE CONTROL IN THE SPOTLIGHT

By **Ben Cullen**, lighting consultant at Opus International Consultants

Glare refers to a bad signal-to-noise ratio: in lighting applications, a 'noisy' high luminance source or reflection that distracts from, or obscures, 'the message'.

It is surprising how difficult glare is to quantify, and how much of a challenge it poses for lighting designers. Inconsistencies have been noted between glare model predictions and the need for more research.[1] Presently, the unified glare rating (UGR) – based on International Committee on Illumination (CIE) consensus – is commonly used for indoor design, and threshold increment and 'G' classes for street lighting.

LED lighting brings further challenges: the market has had an influx of new luminaires with tiny, but powerful, LED sources, very sharp cut-off, and high peak intensities – which can all increase glare. The non-uniform, high-contrast pattern of luminaires that incorporate an array, or line, of LEDs[2] complicates matters further.

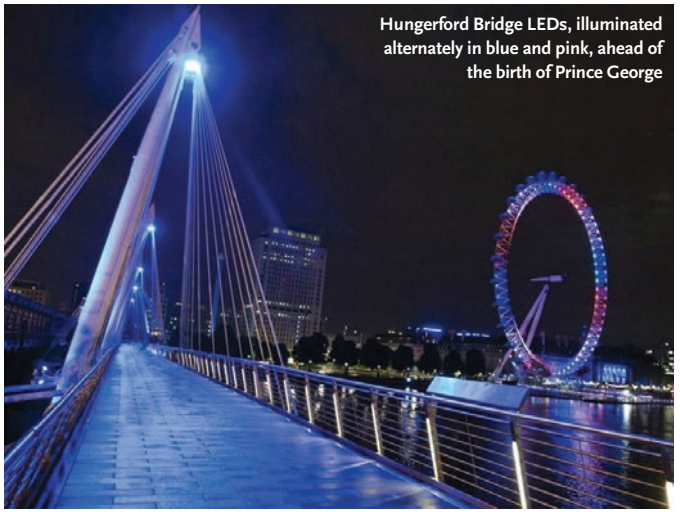
In response, the CIE has proposed a new technical committee to review the impact that non-uniform light sources have on UGR, and propose new measures to manage the effects, or replace the rating system altogether.[3]

References:

1 R.D. Clear, *Discomfort Glare: What Do We Actually Know?*, February 2012

2 CIE report 205:2013, *Review of lighting quality measures for interior lighting with LED lighting systems*

3 **http://malaysia2014.cie.co.at/sites/default/files/gilles_vissenberg-ws4.pdf**



Hungerford Bridge LEDs, illuminated alternately in blue and pink, ahead of the birth of Prince George

appropriately, without discomfort.'

At iGuzzini, this can also be done directly with a text message, with lights being turned on or off – or dimmed – according to the instruction relayed.

Whereas some UK councils have taken to 'switching off' during periods of low vehicular and pedestrian traffic, cities such as Taxco de Alarcón, in Mexico, Recanati, in Italy, Vienna, in Austria, and Jyväskylä, in Finland, have chosen to employ smart-city lighting plans.

'Switching off is not the answer,' says iGuzzini's Servand. 'It reduces safety and fails to connect cityscapes. The answer is better, smarter lighting.'

Street smart

A city-wide lighting masterplan – that connects highways, footpaths, squares and parks – is essential for creating a coherent lighting impression.

When this is carried out with energy-efficient lamps and clever control management technologies, cities can not only benefit from reduced carbon emissions, but even take part in national and global events.

On 4 August, street lights in Westminster were switched off as part of the national Lights Out campaign, marking 100 years since Britain entered World War I. In tribute to the country's fallen heroes, the London borough was plunged into darkness between 10pm and 11pm, as a roll of honour was screened on the Piccadilly Lights.

Westminster's Smart Lights project is expected to save up to £420,000 per year from 2015, and cut carbon emissions by 1,858 tonnes. Savings throughout the 20-year lifespan of the lights is estimated to be £8.4m, and payback for the £3.2m investment is an impressive 7.5 years.

The humble lamppost has come a long way, and just got a whole lot smarter. **CJ**

KEEPING YOUR EYE ON THE BALL:

EIGHT STEPS TO RENEWABLE SUCCESS

The building services industry will struggle to close the energy performance gap, and to maximise heating efficiencies, unless it addresses issues around installation and design of renewable technology, says **Mike Hefford**, head of renewable technologies at Remeha Commercial

> The truth is that too few renewable installations are carried out in such a way as to reach the predicted efficiency level

With the arrival of more advanced technologies in the building services sector, it would be natural to assume an increase in the energy efficiency of buildings, and a reduction in their carbon emissions. Yet research into building performance in new, non-domestic buildings has revealed a significant gap between anticipated and actual energy use – a figure that is often 1.5- to 2.5-times higher than predicted, rising to as much as six-times higher with heat consumption.

This performance gap also applies to refurbishment projects. A report by the Technology Strategy Board, on reducing energy use in existing homes – *Retrofit for the Future: A guide to making retrofit work* – reveals that the total energy used, post-retrofit, on most of the projects in the programme was at least 50% more than predicted, and as much as 100% greater for some.

With steep carbon targets in place – and tighter environmental legislation – renewable technologies are commonly specified as the prime source of energy for heating and hot-water provision on new-build developments. These are often supported by gas-fired condensing boilers, to fulfil the low-carbon requirements of Building Regulations.

Renewable technologies are also increasingly specified on refurbishment projects, as the most effective means of lowering a building's carbon footprint. The problem is, we are not achieving the maximum benefits from this increasingly sophisticated technology.

So why the performance gap, and how can we avoid it?

The temptation might be to point the finger at renewable technology per se. However, the truth is that too few renewable installations are carried out in such a way as to reach the predicted efficiency level. There are a number of crucial steps to follow on the path to renewable success – here's our 'great eight' checklist.

Renewable knowledge

A proper understanding of renewable technologies and how they operate is key. From there, it is one step to thinking the 'renewable way' for optimum results.

Bespoke design

One size does not fit all – each building has its own needs, and requires a bespoke solution. Consider the characteristics of the renewable technology and design accordingly. Heat pumps, for example, use refrigerants that operate more efficiently at lower heating-system temperatures, so these are best suited to underfloor heating or low-grade temperature circuits.

Allow the system to maximise the energy generated from renewable sources; this might mean lowering the flow and return temperatures from 81/72 to 70/50, or to 60/40 on retrofit projects.

Budget permitting, consider recalculating the radiator size in order to lower the system temperatures and deliver the higher seasonal efficiencies. Think outside the box – adding a solar buffer to a heating system will increase the temperature of the cold-water feed and reduce the energy demand.

Size right

If the technology is not accurately sized, the building will not operate as predicted. Accurate sizing requires accurate data, including precise calculations of the base load and the heat loss on the existing equipment.

Avoid basing the heat-loss calculation on the existing equipment, because this will result in over-specification and failure to achieve maximum efficiencies.

Think, too, about how the building and system are to be used. On what is the system designed? What output is required and for what area?

Consider a school requiring 800kW output from a biomass system in winter, but less than half that output in summer. The most efficient solution might be to specify two biomass boilers – one 350kW and one 450kW – which operate together in winter, with the smaller boiler operating alone in the summer months.

Good fit

Poor installation can lead to the low-carbon technology failing to perform as anticipated, with higher-than-expected operating costs.

Where possible, try to use the same supplier, because their knowledge of the various technologies will support smarter system design and installation.

Integration

Good integration is fundamental to efficient operation. On new-build projects, good integration will allow all components in the heating system to achieve their maximum seasonal efficiencies, rather than competing against each other. On refurbishment projects, it is important to address how the new equipment integrates into the existing heating system, to avoid a performance gap.

Get in Control

Advanced controls unite the various technologies in the system, optimising their combined operation and savings potential. A sophisticated BMS will do this and more, integrating the new equipment into an existing system to maximise savings.

SENK/SHUTTERSTOCK

> With steep carbon targets in place, and tighter environmental legislation, renewable technologies are commonly specified as the prime source of energy for heating and hot-water provision

> Building operators should be clearly briefed on the level of maintenance required for their renewable equipment

Commissioning

Projects can – and do – over-run, but it is important to allocate sufficient time and budget for this important stage in the overall design concept. Hydraulic, combustion, and controls commissioning is crucial to ensure the high performance, reliability and efficiency of the heating system.

Maintenance regimes

Building operators should be clearly briefed on the level of maintenance required for their renewable equipment. Biomass systems, for example, require more attention than oil- or gas-fired systems, with daily, weekly, or even monthly involvement of the site staff.

Biomass appliances are also typically serviced twice a year, rising to four times a year depending on operation. Flue cleaning should also be considered on commercial applications, because running hours mean these are more likely to have chimney or soot fires than their domestic counterparts. Regular monitoring of the system's performance – via the BMS control – will also help to eliminate any 'blips', and ensure maximum operating efficiency.

Arguably, the technology is already here to help us progress towards our carbon-reduction goals.

With improved understanding, a switch to 'renewable thinking', and adherence to the 'great eight' checklist, we can maximise the benefits that this sophisticated technology offers us as we move towards a low-carbon future.

Mechanical *and* electrical

The arrival of advanced technology inevitably means additional training for everyone from consultants to salespeople, and from designers to installers. But it can also throw up questions about the structure of our industry, as roles merge or diverge according to new developments. For example, CHP generates power and thermal energy from a single fuel source. When sizing for CHP, two factors require calculation – the thermal and electrical loads.

But are these calculations the responsibility of the mechanical or the electrical contractor? This may not be an issue for larger contractors – who will employ both mechanical and electrical contractors – but, elsewhere, one person could be looking at an aspect that they don't fully understand, or on which they are not yet fully trained. This takes us back to the first point in the 'Great Eight' checklist – the need for in-depth knowledge!

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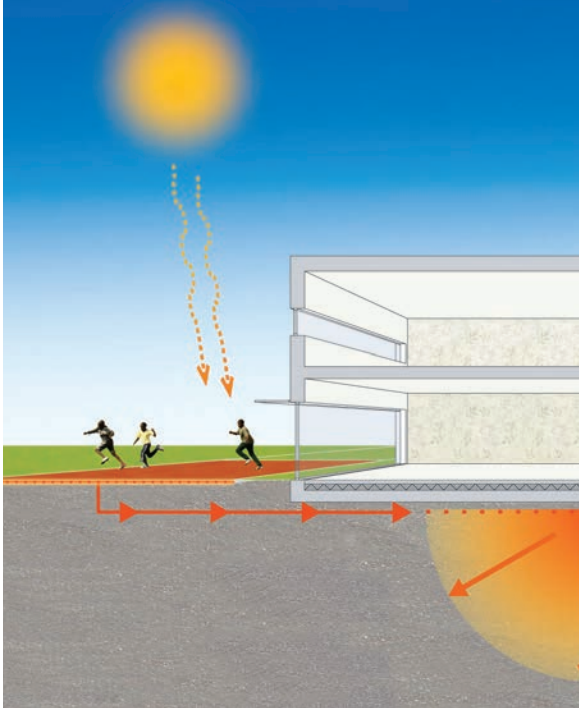
WHAT DOES LIE BENEATH



In response to David Frise's article on ground source heat pump installation issues, **Andy Ford** says the technology *is* viable, and can deliver unparalleled performance efficiency

An ICAX Skid controls the transfer of heat to the ground in summer and of heat from the ground in winter

EDTOR'S NOTE

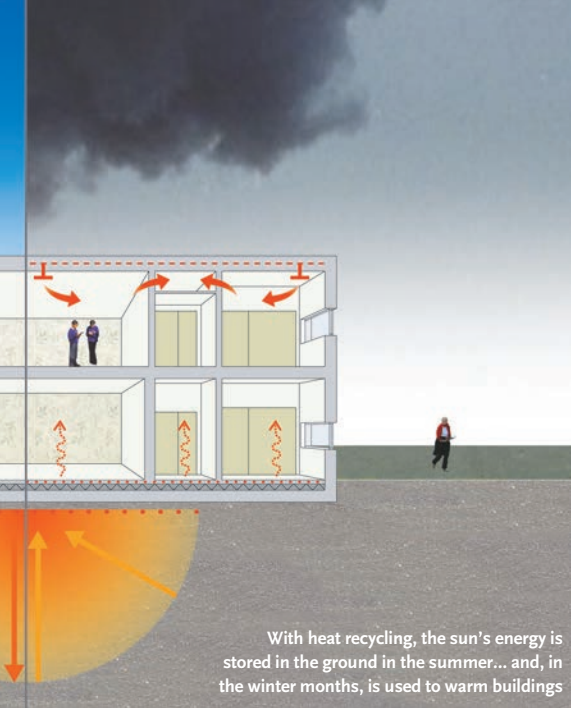
David Frise was referring to pipework above ground. This was not made clear in the article and two captions were wrongly worded to suggest that pipework underground required insulation. Frise says a suprising number of plantrooms are some distance from buildings, and a lack of adequate insulation above ground is resulting in transmission losses.

The article by David Frise – 'What Lies Beneath' – in August's *CIBSE Journal* declares 'that a huge number of ground source heat pumps [GSHPs] are failing to meet their performance targets'. The author goes on to say that 'a reduction of one third of a system's capacity is not uncommon as a result of transmission losses, as heat leaks away from poorly insulated pipework', and a caption states that 'GSHPs need long pipe runs that must be well insulated'. In fact, the long pipe runs used by GSHPs are never insulated – because their purpose is to absorb heat from the ground. [See Editor's note left].

The article suggests that air source heat pumps (ASHPs) should be considered instead, because they 'deliver the heating load at the point of use, without the risk of transmission losses'. A GSHP delivers heat at the point of use – inside the building. An ASHP needs to be located outside a building in order to heat-exchange with ambient air. The key reason a well-designed GSHP has a higher coefficient of performance (COP) than an ASHP on a cold night is that it has access to a higher temperature from the ground than an ASHP does from the air. It is also very significant that a GSHP has a much higher COP for cooling than an air source chiller, because it can heat-exchange with cold ground in summer instead of having to heat-exchange with hot air.

Frise makes the valid point that district heating circuits can lose one third of their capacity as a result of heat leaking from badly insulated pipework. This would be true of a circuit based on combined heat and power (CHP) running high temperatures through pipes in cold ground. However, it simply does not apply to a low-temperature ground source circuit; a heat pump will be placed inside each building – close to where the heating load is needed – and will heat-exchange with the low-temperature heating loop, which draws heat from the ground it passes through.

Frise is right to say a GSHP needs to be designed by someone who understands the heat flows involved. The key is to understand that the most efficient systems are those that are designed to provide heating in winter and cooling in summer, by balancing the desired temperature in the building with the thermal mass of the ground on which it stands.



With heat recycling, the sun's energy is stored in the ground in the summer... and, in the winter months, is used to warm buildings

Insulated pipework connections in a GSHP system

Joined-up thinking points to heat recycling and exploiting the thermal energy capacity of the ground to store excess summer heat until it is needed to warm buildings in the winter. This also means the volume of ground to be addressed with ground loops can be decreased – as can the expense of the installation. Recycling heat also improves the COP of heating in winter and cooling in summer.

The way to achieve intelligent integration and control of heating and cooling is by constructing an accurate thermal model of the building at the design stage, and ensuring a thermal balance is achieved year by year. You can then design a single system to provide both heating and cooling. That would be a very hard job if you overlook the dynamic capacity of the ground to store heat until you need it.

It is correct to say that a GSHP needs to be well designed and well installed. However, this can be said of any heating or cooling system. If you plan to have heat pumps, the installers must have the experience to design, install and maintain an efficient system. **CJ**

ANDY FORD CEng FCIBSE professor of systems engineering in the built environment, London South Bank University

Heat recycling saves heat, cash and carbon

There are significant benefits in a ground source system, says the Ground Source Heat Pump Association's Edward Thompson

To be confident of achieving the benefits that flow from a well-designed ground source system, you need to employ someone with the requisite design and installation experience. This person should also be employed to fine-tune the after installation, as the control system is all important – especially if the heating and cooling loads of the building turn out to be different from those specified at the design stage.

Planning a 'soft landing' is an important aspect of good design, and needs to be verified over the first two heating seasons. A ground source installation will never be the cheapest, but may often be the optimum solution for the owner-occupier over the (very long) life-cycle of a ground source heating system – even before receiving the dramatically increased Renewable Heat Incentive rates for ground source heat pumps (GSHPs).

- GSHP installations have very low running costs because they exploit the fundamental characteristic of the ground to act as an efficient store of thermal energy. In very cold weather, when heating is most needed, a GSHP has access to warmer temperatures from the ground than an air source heat pump (ASHP) has from ambient air
- The thermal energy storage capacity of the ground allows GSHPs to be used efficiently at all times – this provides the opportunity to use GSHPs at night, when electricity is cheaper
- GSHPs do not suffer the 'intermittency' that affects renewable energy from wind turbines, photovoltaic cells or solar thermal panels. Indeed, the thermal energy storage capacity of the ground can be used to compensate for the intermittent supply of energy from other renewable sources
- Ground source heating is one of the most economic routes to on-site renewable heating, reducing emissions of greenhouse gases and meeting the government's binding renewable energy targets
- Although ground source energy requires up-front investment, the reductions in greenhouse-gas emissions are very great, and an investment in ground source energy lasts much longer than investments in other renewable energy. The ground works installed – a major part of the cost – can be expected to last for more than 50 years. The ground source heat pumps are very reliable, with a long life; longer than ASHPs, which have to be located outside, have more moving parts – including air circulation fans – and need to incorporate energy-consuming defrosting elements to contend with the formation of ice in winter. GSHP installations compare favourably with all other forms of renewable heating, and all other mechanisms for generating renewable electricity, in terms of lifespan
- GSHP systems are silent, free from polluting chemicals, reliable and invisible. They are welcomed by planning authorities and architects. They produce no carbon emissions on site, and none at all if powered by renewable electricity. While wind turbines have generated protests and resentment – and government schemes around other technologies have raised eyebrows at the wisdom of excessive public spending – there have never been any political objections to GSHPs
- GSHP systems, uniquely among renewable energy technologies, offer the opportunity to recycle heat energy. This can be captured when it is freely available – in the summer – stored in the ground over the autumn, and released to heat buildings in winter (see diagram), by using the ground for seasonal thermal energy storage, (http://icax.co.uk/thermal_energy_storage.html) – an integral part of ground source energy
- Unlike any other form of renewable technology, the power of a heat pump can be reversed in summer to provide cooling. In the case of an ASHP (or an air conditioning chiller), heat taken out of a building in summer is merely 'wasted' to the atmosphere. It is a very expensive option to provide cooling by heat exchange with hot air. The radical, renewable, cooling alternative is to use a GSHP to heat exchange with cold ground
- A by-product of renewable cooling is the ability to deposit heat into the ground – in advance of the time, in winter, when the heat pump will extract heat from the ground
- Ground source energy installations require a detailed understanding of local geology and conditions – and so provide skilled employment in Britain for local expertise, in designing an appropriately sized system, and local employment when it comes to installing the ground works
- GSHP systems contribute to the energy security of the UK by providing heating and cooling from energy that occurs naturally in the UK, instead of relying on imported fossil fuels.

Getting INTO PRINT

Is 3D printing just the latest fad to get engineers over-excited or a manufacturing breakthrough that will change the face of building services projects? **Ewen Rose** asks the experts

An architectural 3D model by Hobs Reprographic, with 'windows' printed using transparent acrylic

> With 3D printing, engineers can constantly refine and remodel components in a way that simply would not be possible – for financial and practical reasons – in conventional manufacturing

WATCH NOW
An introduction to 3D printing at www.cibsejournal.com

In 1981, Chuck Hull was a frustrated man. His company put plastic coatings on furniture, but – back then – it could take months to design, manufacture and deliver even fairly basic plastic components.

Hull thought there must be a better way, so he invented 'stereolithography' – a means of producing three-dimensional objects by layering up thousands of thin sheets of plastic, and using light to change their shape.

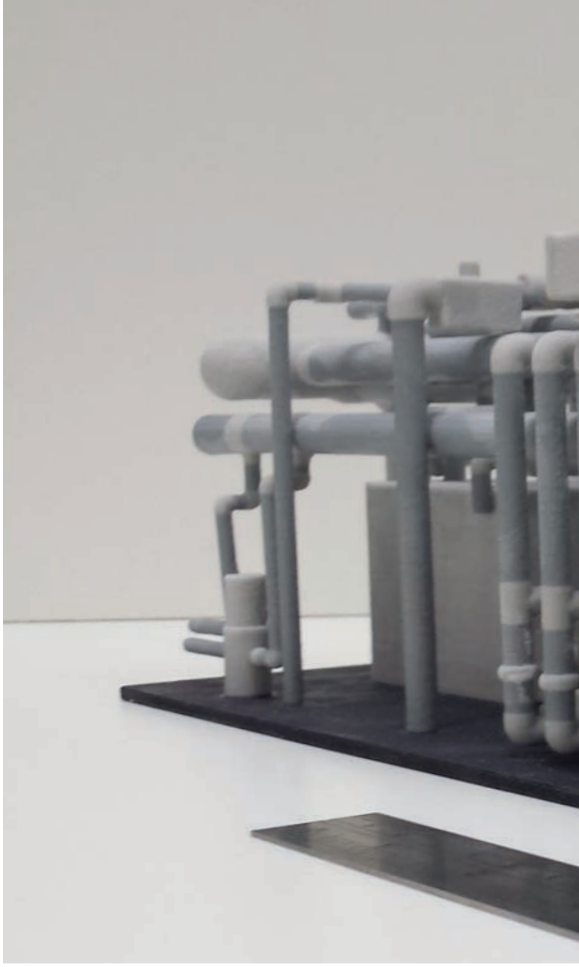
Over the next three decades, Hull and the company he founded, 3D Systems, refined and improved the process that we now refer to as 3D printing – or additive manufacturing (AM). Hugely complex and expensive to start with, modern versions of his first machines are now widely available for as little as £600.

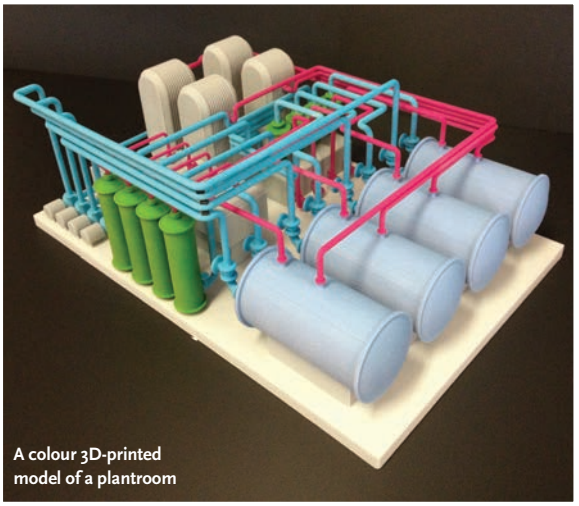
The motor industry, early on, spotted the technique's potential for improving the way it created prototypes, while the medical profession was enthused about using 3D printing to produce surgical instruments. Now engineers across the globe are getting excited about the possibility of using the technology to go from digital design model directly to physical product.

Real-world construction

In Holland, architects are already working on the first 3D-printed house by layering up construction blocks. Arup's Amsterdam office is also pushing the technology into what it calls 'the realm of real-world, hard-hat construction'. Hobs Reprographics, meanwhile, prints 3D models for the engineering and construction industry, and recently printed an intricate model of Victoria underground station for Transport for London (TfL – see image on page 42).

'TfL plans can be really complicated, with multiple levels. It's about understanding how the design works as a whole,' says group marketeer at Hobs Reprographics, Paul Ryan.





A colour 3D-printed model of a plantroom

The model is currently being used on site as a working model. 'It's much easier to refer to an actual model than look at different plans in two dimensions,' says Ryan.

Hobs Reprographics has also recently started printing plantrooms for clients. 'Traditional plantroom models have to use bendy straws: it's complicated and the accuracy is not great,' says Ryan. 'You can easily see how plantrooms can be maintained with a 3D printout. Often, designs have railings that block access for repairs and maintenance.'

Arup's engineering consultants have used 3D printing to produce steel nodes suitable for a lightweight structure. They believe this has the 'potential to reduce costs, cut waste and slash the carbon footprint of the construction sector'. The nodes display the complex geometry to showcase 'the possibilities of

Hobs Reprographics is printing out 3D models of plantrooms to help designers plan maintenance access

this new technique', according to team leader Salomé Galjaard. 'This approach potentially enables a very sophisticated design, without the need to simplify it at a later stage to lower costs,' she says, although she adds it is still only possible to produce relatively small pieces.

'At the moment, we are stuck to the building chamber size – varying per machine, but, indeed, still relatively small. The [3D printing] industry is working on producing bigger machines, but we have never worked with them before. We need to tell them what we need... machine size, but also material qualities – and possibly other things.'

'I believe the AM industry is very willing to support us as best as they can,' Galjaard adds. 'Large products will, of course, be more expensive but, with smart design – fitting multiple products in a building chamber – and innovations such as using multiple lasers and stronger lasers, these costs can be reduced.'

Using 3D printing is currently an expensive way to produce building components. However, there is the potential to scale-up production hugely so that a cost point is quickly reached that brings the technique into play in building services, which relies on a large number of relatively complex components.

'Next to weight reduction, I believe product integration is one of the main added values of AM,' says Galjaard. 'Building relatively small, complex products – possibly one-offs – is where I now see the most added value. The next step in our research is focusing on product integration, putting all the complexity into one product, so all the others can be really simple.'

Mind-blowing

Galjaard believes it will be a long time before AM is a common technique – and that far more experience is needed to gain 'insight into material characteristics and product reliability' – but, she says, the long-term possibilities are 'mind-blowing'.

With 3D printing, engineers can constantly and repeatedly refine and remodel components in a way that simply would not be possible – for financial and practical reasons – in conventional manufacturing. The final product can be very complex because of the layering process, which allows a programmer to add more and more detail. However, the secret of success is making sure the eventual design can be easily reproduced, so the price per unit comes down. The Arup team points out that, if you take the life-span of a product into account, AM is already saving money.

'Direct production costs might be more expensive for quite some time, but this also

IN CONTROL

Monodraught uses 3D printing for prototyping new components. It used the technology to refine designs of a backplate and bezel for the control panel of its Cool Phase cooling and ventilation system. It was able to experiment with various frame and fixing arrangements to ensure a snug fit for the LCD screen. 'It's really beneficial, as we can figure out the solution before it goes to tooling,' says Monodraught product design engineer Sam Whitfield, who says the mock-up gives salespeople an opportunity to incorporate client feedback.

'A 3D printout gives you a first-hand look at how the product behaves,' says Whitfield.

Read more on 3D printing in 'Well worth the plastic it's printed on...' *CIBSE Journal*, January 2014

> As the printers get bigger, who knows what that could lead to? Perhaps printing whole ductwork sections

Arup's design for a steel node

depends on the project and where parts are produced,' says Galjaard. She adds that AM is not 'disruptive in a sense that it will make all other production techniques obsolete. We just have an extra option to choose from – and, for designers, that is a great thing to have.'

Ventilation and cooling firm Monodraught is already using 3D printing to refine the designs of new components, and says it helps to reduce time spent prototyping (see box).

AECOM director Ant Wilson, meanwhile, also thinks the technology will become a useful addition to the industry's armoury because of its ability to improve resource efficiency – although he questions the need to further increase complexity. 'You could argue that we should be simplifying our designs, and looking to use more standard components, rather than finding ways of delivering more customised solutions,' he says.

'However, 3D printing is ideal for producing very detailed components and relatively complex shapes. Traditional milling of metal components leads to lots of waste, which can be avoided by using a 3D printer. Also, the approach of going straight from CAD model to the production of complex objects is extremely efficient.'

The technique can also help the building services industry respond to architects' appetite for complex, fluid geometric shapes, because these can be achieved more cost- and resource-efficiently than with traditional methods. It is not yet able to deliver large, detailed pieces of plant – such as air conditioning chillers – but 3D printing could produce spare parts quickly and, eventually, at lower cost. It, therefore, has the potential to speed up repair work and extend the operational life of large systems.

'You might not need a stock of spare parts – just a printer,' says Wilson.

At the installation end, 3D printing could solve several problems for contractors, according to Bob Towse, head of technical and safety at the Building & Engineering Services Association (B&ES). 'It is early days, but the potential is very exciting,' he says. 'You can now buy the printers very cheaply, which means many more people can have access to this technology. I think we will see building services components and spare parts being printed on site in the not too distant future.'

Cutting costs

Towse believes this could revolutionise the way systems are constructed, by cutting transportation and manufacturing costs, and speeding up projects.

'It will be much easier to have a 3D printer on site than all the various pieces of equipment you currently have to order, and wait on to be delivered,' he says. 'The steel elements for ductwork erections are an obvious starting point, but you could also produce boiler parts, pump components, and valves on the spot – and that has huge implications, especially where site access is tricky.'

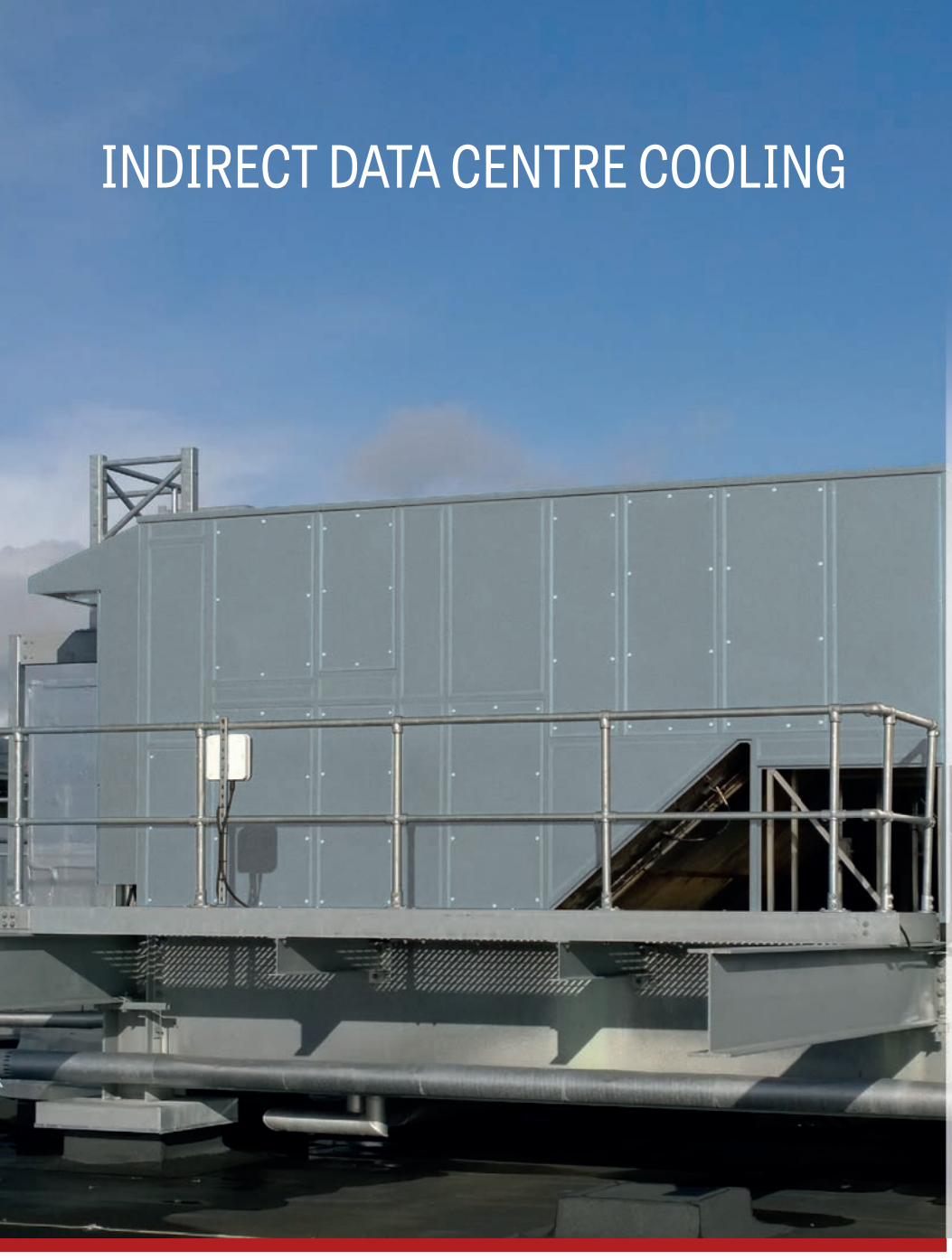
Being able to print new parts of a system on site could also solve many of the delays created by design clashes, Towse believes. 'Rather than having to take everything apart, you could just print new components to different specifications and work round the problem,' he says. 'At the moment, the printers are predominantly working in plastics, but it will not be long before they can produce a range of components made of some of the softer metals – and, ultimately, steel. Equally, as the printers get bigger, who knows what that could lead to? Perhaps printing whole ductwork sections.'

Towse does urge caution, however, pointing out that the industry is still a long way from being able to produce complex products in this way. There could also be some issues with system security. 'The design is driven by digital files, so there will have to be very robust protection from computer viruses,' he says.

In general, though, the reaction to 3D printing across the sector is positive, and potential benefits now seem more realistic. Most exciting for building services engineers is the prospect of AM machines – capable of dramatically cutting the time from concept to production and installation – becoming standard features of design engineers' offices and building sites in the near future. **CJ**

3D printed components of Victoria underground station being assembled at Hobs Reprographic

INDIRECT DATA CENTRE COOLING



2009 *Test Laboratory I opened*
Working prototype

2010 *On-going research & development*
Breakthrough in HEAT EXCHANGER technology

2011 *Excool installed on 9MW data centre*

WINNER
DatacentreLeadersAwards2011

2012 *Excool installed on 6MW data centre in The Netherlands*

InformationAge
AWARDS2012 WINNER
GREEN IT INNOVATION OF THE YEAR

2013 *New test Laboratory II opened*
Excool awarded contracts for on-going 46MW data centres

datacentre solutions awards 2013 Winner

2014 *Excool being installed in data centres totalling in excess of 100MW*
BRILL award from the Uptime Institute using Excool's cooling technology
New 600KW 400m² customer demonstration test facility opened

Uptime Institute
BRILL AWARDS FOR EFFICIENT IT
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WINNER

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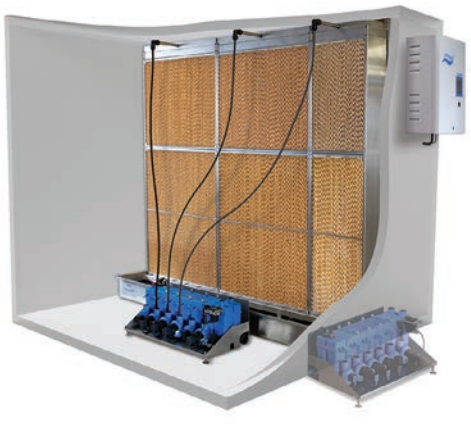

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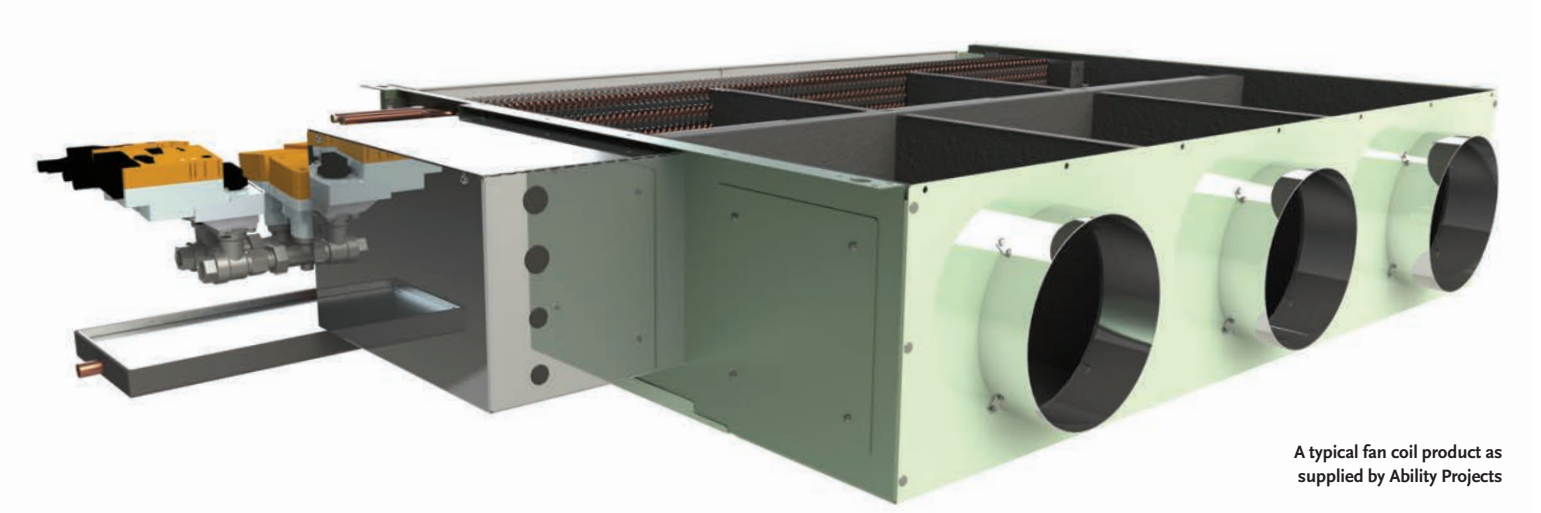
This month: New research compares performance of fan coil units with chilled beams; managing air movement in operating theatres; recovering heat from sewage; and another tale from the plantroom

A COOL RESPONSE



A typical fan coil product as supplied by Ability Projects

Last year, a report on chilled beam performance claimed significant energy savings over fan coil units. This year, the fan coil industry has hit back with a report of its own. **Andrew Brister** looks at the findings

Mirror, mirror on the wall, who is the fairest of them all? Beauty is in the eye of the beholder, but less subjective is energy performance. Which air conditioning system is going to give you the lowest energy consumption for a specific set of conditions? With today's modelling software, the answer should be easy, but an ongoing debate between chilled beam and fan coil unit manufacturers shows how the figures change, depending on variables such as chiller flow and return temperatures.

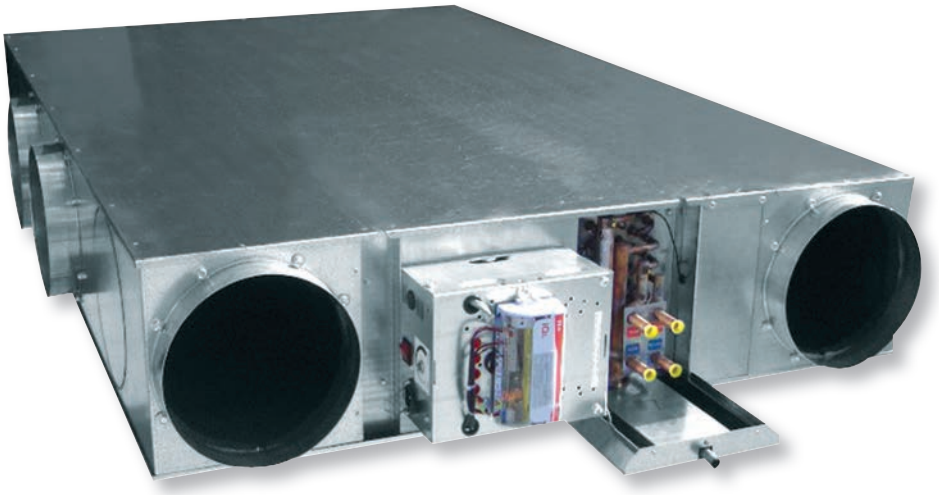
Last year, the Chilled Beam and Ceiling Association (CBCA) commissioned a study comparing HVAC systems. The CBCA report, carried out by consultant EDSL using its Thermal Analysis Software (Tas), revealed the potential for energy savings of 17-22% with chilled beam against variable air volume (VAV) fan coil systems.

Not surprisingly, the fan coil unit sector hit back. 'While the report claims to be a fair comparison, the CBCA have failed to use identical design criteria which, unfortunately, cause an unfair comparison to be drawn,' said John Lightfoot, chair of HEVAC's Fan Coil Unit Group (FCUG). The FCUG argued that the CBCA study used 6°C flow, 12°C return temperatures for the fan coil system and 14°C flow, but 17°C return temperatures for active and passive chilled beams, making the system comparison biased towards chilled beams. 'To produce a fair comparison, 14°C flow, 17°C return temperatures could have been used for all three systems,' said Lightfoot.

Dr Alan Jones, managing director of EDSL, responded: 'We were asked to use these temperatures to represent the most widely used practice and to create a base line, as both VAV fan coils and active chilled beams can elevate their chilled water flow temperature from their base lines. The improvements in chiller coefficient of performance (COP) and amount of DX cooling offered by the high chilled water temperature is the difference in energy consumption between the systems. The VAV fan coil terminal fans are so efficient that they have a secondary effect on relative energy use. I believe the energy use debate is down to water supply temperature.'

Now the FCUG has put that theory to the test, commissioning EDSL to compare the energy consumption of fan coil units (FCU) and active chilled beams (ACB) under the same conditions. A typical office building

> The purpose of this report was to further emphasis the point being made in the CBCA report that higher water temperatures and free cooling can indeed save significant amounts of energy



Fan coil units were modelled against active chilled beams in the analysis by EDSL

has been modelled to give realistic heating and cooling loads, and two HVAC systems will calculate the FCU and ACB energy consumptions, which are then compared.

The building model

An eight-storey office building was used, with a rectangular footprint of 35m x 50m, and 2.8m ceiling height. The office areas were assumed to be open plan, with an internal 8m x 4m core area for lifts, stairs and WCs in the centre. The building was assigned Part L2 notional constructions and glazing percentages. The building was zoned with the NCM (National Calculation Methodology) Modelling Guide and incorporates 6m wide perimeter zones so the differing façade solar gains could be analysed. The standard NCM office internal conditions were also applied, giving this building the energy consumption of the NCM 2013 Part L2 target. Standard CIBSE London weather data was used.

Air-side systems

The fresh air supply system is identical in both FCU and ACB models, supplying 12 l/s/person during occupied hours. The supply fresh air was controlled to 16°C throughout the year. A heat recovery system with 70% efficiency was included; again, an NCM notional requirement. No de-humidification of the incoming fresh air was needed in either model as there was no latent heat removal, and no humidification of the supply air included.

A Specific Fan Power (SFP) of 1.8 W/l/s was used for the supply fan in the FCU model, while an SFP of 1.9 W/l/s was used for the ACB model, to account for the higher supply pressure needed to induce flow in the room. No additional distribution loss was included in the ACB system due to higher duct pressures. Both models used an SFP of 0.3 W/l/s for the return fan. The part load efficiency of the terminal fan in the FCU model was assumed to follow the 'square law' curve. A fixed induction rate of 4.5x fresh air supply flow rate was used in the ACB model. The FCU model allowed the terminal fan to turn down to 50% of design flow rate at off peak conditions. The terminal fan pick up was assumed to be 100%.

No chilled beam or coil performance data was needed in either model, as the equipment was assumed to be sized to deliver peak heating and cooling demands. Both systems have a parasitic power consumption of 1.8kW overnight, rising to 2.4kW during the day.

Plant room systems

The plant room model was identical for both systems. Lochinvar Crest condensing boiler performance data was entered for each boiler. Efficiency varied with return water temperature, as well as outside wet bulb temperature (correctly accounting for actual condensing performance). Chiller performance was based on the Carrier 30XA series, with efficiency varying with part load and outside dry bulb temperature. The design supply and return temperatures for the chilled water loop were 14°C and 17°C respectively. Valves controlling flow to both were assumed to be tuned to optimise free cooling with the following part load control of the return water temperature for the ACB model (Figure 1).

The FCU model used the following return water temperature control (Figure 2) – slightly less advantageous in terms of free cooling.

Free cooling was implemented via a dry air cooler (DAC). The performance of the DAC was taken from the Alfa Laval Fincoil Solar Max data. Fan SFP was 0.0333 W/l/s and overall exchanger efficiency was set at 0.67. NCM distribution efficiencies were: 80% for cooling; 90% for heating and 95% for HWS.

The ACB model

Part load	turn temperature
100%	17°C
75%	18.8°C
50%	20.8°C
25%	22°C

Figure 1

The FCU mode

Part load	Return temperature
100%	17°C
75%	18°C
50%	18.8°C
25%	20°C

Figure 2

Results

Hourly annual energy analyses were carried out: one for the ACB, and three for the FCU. The three FCU runs were modelled with terminal fan SFPs of 0.3, 0.2 and 0.15 W/l/s, with 0.2 W/l/s being good practice (Figure 3).

The table in Figure 4 summarises the relative total annual energy consumption for the various FCU systems. This report backs up Jones' claims that the difference lies predominantly with water supply temperature, with the FCU energy consumption coming in at only 0.85% to 2.87% more than a chilled beam system. 'The purpose of the report was to emphasise that higher water temperatures and free cooling can indeed save significant amounts of energy – and therefore money – and this, of course, applies whether using chilled beams or fan coils,' said Lightfoot.

'While, as with chilled beams, a fan coil system running on higher water temperatures will have a higher capital cost than a system running on traditional temperatures of 6°C flow and 12°C return, the running costs make the additional capital costs worth considering,' he said. 'With fan coils optimised for the higher water temperatures, this increased cost can be kept to a minimum.'

Results for the ACB Model

	Heating kWh	Cooling kWh	Auxiliary kWh	Total kWh
Annual demand	152382.3	479420.9	159929.8	791733
Annual consumption	161461.8	108463.5	159929.8	429855.1

Results for the FCU with terminal fan SFP of 0.3 W/l/s

	Heating kWh	Cooling kWh	Auxiliary kWh	Total kWh
Annual demand	149526.1	496035.5	171271.6	816833.2
Annual consumption	158457.5	112482.2	171271.6	442211.3

Results for the FCU with terminal fan SFP of 0.2 W/l/s

	Heating kWh	Cooling kWh	Auxiliary kWh	Total kWh
Annual demand	150477.6	492109.9	165361.5	807949
Annual consumption	159458.4	111586.1	165361.5	436406

Results for the FCU with terminal fan SFP = 0.15 W/l/s

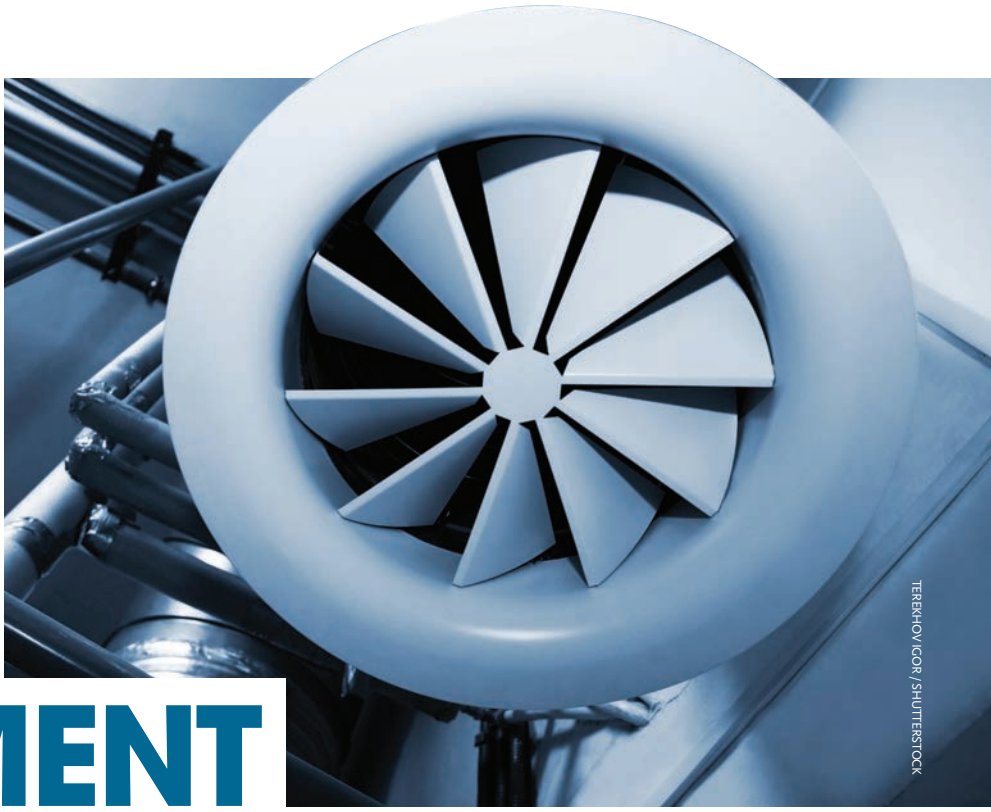
	Heating kWh	Cooling kWh	Auxiliary kWh	Total kWh
Annual demand	150954.9	490143.1	162403.5	803501.5
Annual consumption	159960.4	111137.1	162403.5	433501

Figure 3

At the end of the day, you pays your money and you takes your choice. 'Of course every system has advantages and disadvantages but, as can be seen from this report, a fan coil system's energy consumption is not one of them,' said Lightfoot. **CJ**

Terminal Fan SFP	% above ACB
0.3	2.87
0.2	1.52
0.15	0.85

Figure 4

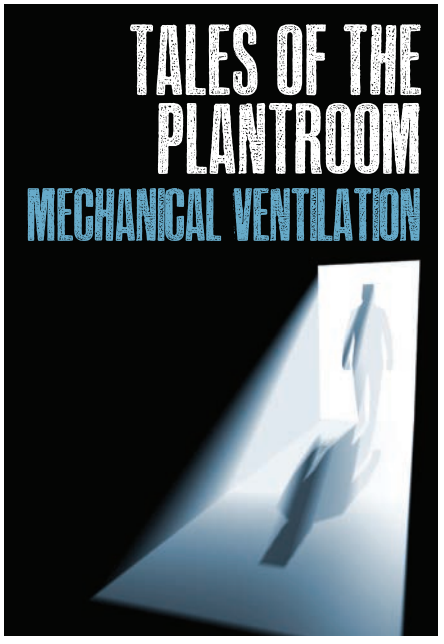


TERKHOV IGOR / SHUTTERSTOCK

Variable speed drives are the default energy-saving solution for ventilation systems – but that should not blind designers to other ways of making air movement in buildings more efficient, says **Matt Fulford**

MOVEMENT FOR CHANGE

> The ventilation system can be used as an energy-saving measure in its own right, by pumping in passively cool air at night and sucking out excess heat by day



The standard response to which energy-saving measure to use for ventilation/air handling units (AHUs) tends to be 'stick on a variable speed drive (VSD)' – but there is so much more that can be done.

The first thing to consider is why you need mechanical ventilation. In the case of WC extract, it may be to remove odours – in which case, there is little need to run it 24/7.

In schools, I have seen mechanical ventilation to ensure low CO_2 levels in classrooms – which also have windows that open – running from 7am, in line with the heating time zone. However, students did not enter the room and start increasing CO_2 levels until 8.45am. Reducing the ventilation timing can, therefore, reduce the heat loss, and allow heating optimisers to be shortened and rapidly raise the temperature of the building.

With ventilation, it is the fan motor that consumes the direct energy, but the effect it has on heating and cooling has a larger impact on overall building efficiencies. A VSD will help – but how is the speed being controlled and varied? For extract fans, it might be best to control CO_2 levels and, on the supply fans, it is perhaps best to control the air pressure. The pressure then brings in another issue – that of filters in the supply air duct.

Most supply air is filtered, and keeping the intake grilles and filters clean and clear is important because this will keep energy use under control. There are also low-loss filters that reduce the pressure lost through the filter itself. When used with VSDs, these are a very effective energy-saving measure.

Then there is the impact that ventilation systems have on heating and cooling, especially in large AHU systems that have heating and cooling coils in the ductwork. How well are the coils insulated? Too often they put their energy into the outside air.

The use of heat exchangers to recover the temperature of the exact air into the intake can help with heating and cooling, However, the ventilation system can be used as an energy-saving measure in its own right by pumping in passively cool air at night and sucking out excess heat by day. If the building has a heavy cooling load, running the ventilation as a night-time air purge can significantly reduce the cooling load with a few changes to the controls strategy. With a recirculation link, and some air-quality sensors, the load on the heating and cooling coils can also be significantly reduced.

To increase the efficiencies of a ventilation system, therefore, understand why it is needed, use it for that purpose, and – whenever possible – efficiently recycle the heat, cooling and fresh air within it. **CJ**

MATT FULFORD is the director of Inspired Efficiency, helping organisations to reduce their energy and water costs and emissions by reducing their demand.

HOT FLUSH

Recovering heat from sewage is an established technology in North America. Now a British company, Sharc Energy Systems, wants to pioneer its use in the UK. **Russ Burton** explains

> The warmth of the sewage water helps to improve the efficiency of the heat pumps deployed, thereby recycling heat that can then be used in domestic appliances

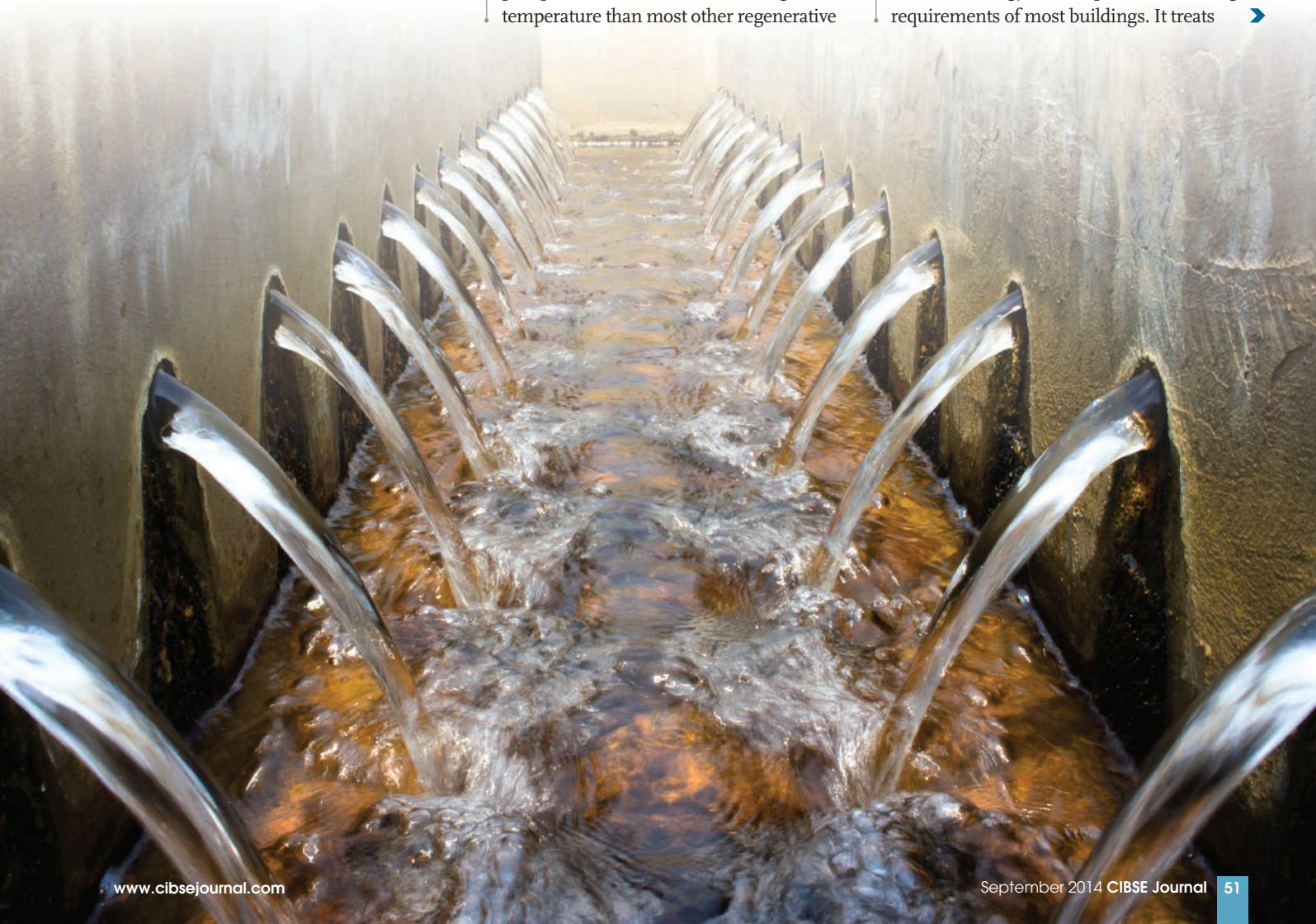
Waste-water heat-recovery systems use raw sewage as the energy source for heating, cooling and domestic hot-water. With 10bn litres of sewage created in the UK every day, waste water is a constant, inexhaustible source of latent heat, sufficient to meet the heating and cooling requirements of every industrial building in the UK.

Sewage heat recovery provides year-round, low-grade waste energy for delivery to heat-pump installations. It achieves a higher temperature than most other regenerative energy sources – such as well water or geo-exchange – reaching an average of more than 21°C (77°F) when exiting buildings.

A hot resource

The process is simple. Sewage heat-recovery systems use a building's waste water, which consists of whatever gets flushed down the toilet, mixed with millions of gallons of hot water from showers, dishwashers and washing machines. This maintains a fairly constant temperature as it travels through sewers to the treatment plant.

Sharc Energy Systems uses a clog-proof, raw-sewage filtration system, and heat-exchange technology that conducts the heat from untreated waste water. The filtration system separates the solid and wet content of the sewage flow to allow extraction of sufficient energy for the space-conditioning requirements of most buildings. It treats



GAMEANNA / SHUTTERSTOCK

and cleans the raw sewage, and then uses it to create a highly cost-effective alternative heat source. Smart technology and heat-recovery engineering make the system reliable, affordable and low-maintenance.

Proprietary control panels include real-time read-outs, and the system incorporates software to monitor and predict usage trends and maintenance issues.

Every system is supported by a control package that is centrally monitored, enabling the Sharc team to predict and respond to system performance and maintenance requirements before the client experiences loss.

The warmth of the sewage water helps to improve the efficiency of the heat pumps deployed, thereby recycling heat that can then be used in domestic appliances, such as washing machines, showers and even radiators. It all operates as a closed-loop system, ensuring the dirty water never touches the clean water.

The relatively high temperature of the primary side of the heat pump helps to drive higher efficiencies than heat pumps deployed under other technologies.

Opportunity

The thermo-mechanical methods used are efficient, cost-effective, scalable and reliable, providing a sustainable, odourless, heating and cooling source for a variety of buildings.

The Sharc system can be deployed wherever there is a sewage resource, captured or municipal: in new-build and retrofit projects; on residential and commercial developments; and across a broad range of building types where there are large numbers of people – hospitals, prisons, student accommodation, leisure centres, retail developments, shopping centres, industrial complexes, multi-site and multi-occupancy residential developments.

Interest in the system is growing, and Sharc has already done a number of feasibility studies for district heating systems, the healthcare sector, and large commercial property owners. The company's aim is to complete four installations within our first year, and a further 10 by the end of 2016.

The challenge

Natural resources are steadily being depleted, with more than 60% of the world in fuel poverty. It is imperative that an alternative to traditional fuels is embraced as we face 'carbon crunch' – one of the biggest challenges of our generation.

Sewage heat recovery is the ultimate in cost-effective renewable energy sources, and is a massive opportunity to save energy that would otherwise simply go down the drain. It is a highly realistic alternative energy supply that uses an all-but endless source of alternative, renewable energy.

The government's ambition for heat-pump technology to be more widely adopted as the primary heating and cooling system in modern buildings is gaining momentum; the Renewable Heat Incentive is a genuine opportunity for the industry to establish itself as the first stop for building designers and specifiers looking for genuinely low-energy heating and cooling systems.

Sewage heat-recovery systems are viewed as a fledgling technology in the UK, so Sharc is working hard to educate public and private sector organisations about the value of the system – its cost, energy efficiency potential , and environmental benefits.

Since our UK launch in June, we have been working to build relationships with the country's water companies, to enhance their understanding of opportunities and benefits in sewage heat recovery – for them and for larger customers. **CJ**

RUSS BURTON is the chief executive officer of Sharc Energy Systems

CASE STUDIES

The Sharc sewage heat recovery system has been installed in a number of locations in Canada and North America.

Sail Condominium Project, University of British Columbia, Canada

The Sail – a new, 172-unit condominium project – is the largest Sharc installation to date, and the highlight of a sustainable community plan at the University of British Columbia. The Sharc system produces hot water and helps to heat the building via radiant floor heating. The system generates 500,000 kWhs per year – reducing annual emissions by 100 tonnes – and operates at 80% efficiency.

Seven35, Vancouver, Canada

The Seven35 Building – by Adera Developments, and situated on the north shores of Vancouver, Canada – offers a variety of sustainability features. This multi-award-winning development consists of 60 town homes, and was the site for the first installation of the Sharc sewage heat-recovery system.

The developers chose the Sharc system in preference to solar panels, which would have been installed on the roof. This freed up space to incorporate roof gardens and hot tubs, which have added significant value to the development.

CASE STUDIES

The Gateway Theatre, Vancouver
The Gateway is a 50,000ft², multi-use public theatre facility. As part of Vancouver's carbon-reduction strategy, the Sharc system was installed, reducing the venue's emissions by 50 tonnes per year. The existing system was an incremental heat pump system, supplied by a boiler and cooling tower using 29 heat pumps. With a design flow of 900 litres per minute from a city source, 1.2 GWhs are produced.

The Sharc system has FHP* heat pumps with double-walled, vented heat exchangers that recover waste heat from the exiting raw sewage and move that heat into 6 x 450-litre domestic hot-water storage tanks. Flow meters, temperature sensors and electrical meters monitor and log system operation, plus energy used and recovered.

*FHP is a California-based manufacturer of water source and geo-thermal heat pumps. Sharc systems installed in Canada use FHP heat pumps. In the UK, Sharc is researching the existence of similar quality and performance heat pumps to be used in all installations.

> Sewage heat recovery is the ultimate in cost-effective renewable energy sources, and is a massive opportunity to save energy that would otherwise go down the drain

PURE THEATRE

A well-designed and maintained ventilation system is vital to ensuring the highest levels of infection control in operating theatres, but it hasn't always been clear precisely what the best approach is. **Jonathan Paradi** offers some expert advice

My experiences using the Department of Health (DoH) guidance while working at London's Great Ormond Street hospital, serve as a brief history both of recent design developments in ventilation systems for operating theatres, and the pitfalls engineers can encounter. It's important for designers to understand not only the relevant guidance but also the background to target figures. Equally, it's imperative the hospital estates team fully comprehends the design they have, how it works and how to maintain it. Here are some of the main issues which have arisen in these most critical of environments.

Confusion over air changes

The current guidance notes from the DoH for ventilation in healthcare premises is HTM 03-01. This was released in 2007, superseding HTM 2025, which was used since 1994.

The Joint Working Party on Ventilation in Operating Suites (1972) – also known as the Lidwell Report, advised that clean areas (operating theatre and preparation room/ similar) should have ventilation equivalent to 20 air changes per hour (ach,h^{-1}). If the suite was built with the ventilation requirements in HTM 2025, the size specifications in HBN 26, or the standard sizes available from the DoH's activity data base (ADB) system, then this delivers somewhere between 19.5 and 23 air changes per hour.

ADB was a remarkable system that allowed architects to build standard NHS areas which conformed to the available guidance. It had tried and proven room datasheets which contained all relevant information on, for example, the quantity of sockets, lighting and ventilation levels. This guidance is more often found in the health building notes (HBNs).

HTM 2025 provided volumetric airflows for standard room layouts (Figure 1), for example 0.65$m^3 \cdot s^{-1}$ for a standard operating room.

However, where designers had to work within an existing building envelope and other constraints, the spaces built into operating theatres inevitably differed from the stipulated sizes. In most cases, the trend was to make the theatre suites as large as possible to maximise clinical productivity and access during procedures. The result of these relatively minor changes was a drop of air changes per hour, in some cases to as low as 11ach – well below the target of 20ach.

KEY TO SYMBOLS

Supply $m^3 \cdot s^{-1}$

Extract $m^3 \cdot s^{-1}$

Door (double)

Door (single)

Door mounted transfer grille

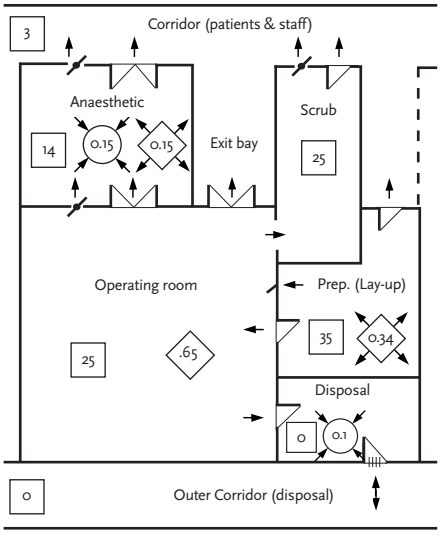


Figure 1: Extract from HTM 2025 Plan 1b showing specific air volumes only[1]

When HTM 03-01 was introduced, the target air changes per hour were increased from 20 to 25 within theatre spaces. No longer did this document have to be cross-referenced with the now scarcely available ADB layouts, but actual air changes per hour were quoted.

HTM 03-01 also aimed to clarify some of the previously published information. Retrospective guidance for systems designed under HTM 2025 (Figure 2) made it clear that the intent was always to deliver about 20ach.

Theatres falling short of this should be reviewed and ventilation rates increased.

Room pressure

Room pressures are a critical aspect of a well-commissioned operating theatre. Guidance has been quite clear on the required design targets, but there is some confusion within the NHS over what theatre type is suitable for certain procedures. This has resulted in some theatre suites being unfamiliar to their estates departments and infection control teams.

The classic example here is the difference between a standard theatre with a lay-up preparation area, and a standard theatre with sterile pack prep. In lay-up prep, medical practice suggests the instruments, medicines and other supplies required for the operation are 'laid up' within the prep room; the removal of packaging takes place as the equipment trolley is being prepared. It is common for these items to be left within the room for an hour or so before they are brought into the operating room itself. With sterile pack prep, the equipment required for the intended operation is stored within the prep room, but lay-up takes place within the operating room itself.

It is important for all concerned to understand what type of theatre they have, as the air requirements differ dramatically. With a theatre suite not having an adjacent sterile store, it is common to store the 'packs' within the prep room and layup in the theatre (sterile pack prep theatre). However, where the theatre suite is adjacent to other suites, it's

It is important for all concerned to understand what type of [operating] theatre they have, as the air requirements differ dramatically

KEY TO SYMBOLS

- Supply volume ($m^3 \cdot s^{-1}$)
- Extract volume ($m^3 \cdot s^{-1}$)
- Nominal room pressure (Pa)
- Air change rate (ach)
- Pressure stabiliser
- LLE — Optional low-level active extract or pressure stabiliser. May be added during refurbishment to assist air distribution in theatre
- Transfer grille

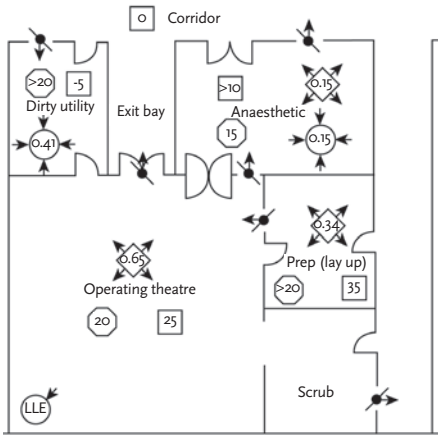


Figure 2: Extract from HTM 03-01 (retrospective plan 1b for old guidance 2025) showing specific air volumes and intended air changes per hour

HXDBZXY / SHUTTERSTOCK

Estate departments and infection control teams should understand what type of theatre prep their suite has

> Nearly all theatre plant requires some degree of adjustment from year to year – the challenge has always been minimising the amount of attention needed

more suited to having a separate sterile store (normally part of the same area as the entry bay/clean corridor) – a lay-up prep is typical – because unboxing occurs and a higher ventilation rate is stipulated, higher even than the surgical area or operating room itself, as the main route of airborne contamination entering surgical wounds is generally considered to be via the operating instruments (see Figure 3, below).

Doors and infection control

Within healthcare there is a tendency for some operating staff to prop doors open. However, this alone should not cause a problem in terms of infection prevention.

The thinking behind the pressure regime is that air moves in defined directions (generally from more sterile to less sterile areas) and higher pressure to lower pressure, with the magnitude of pressure in each room determined by the area under control. For example, there should be 10Pa differential pressure (DP) between the lay-up prep room and the operating room.

If the door between these two rooms is propped open, while the measurable DP between the two rooms will fall, the velocity of air through the opening will be sufficient to maintain what infection control calls 'open door protection'.

Again, there exists some confusion within design about how these pressures can be controlled. The accepted method is to use a weighted damper (pressure stabiliser), the movement of which compensates for small variations in pressure.

It is important to note that the balance of pressure tends to drift as filters and ductwork age. HTM guidance requires theatre plant to be validated annually.

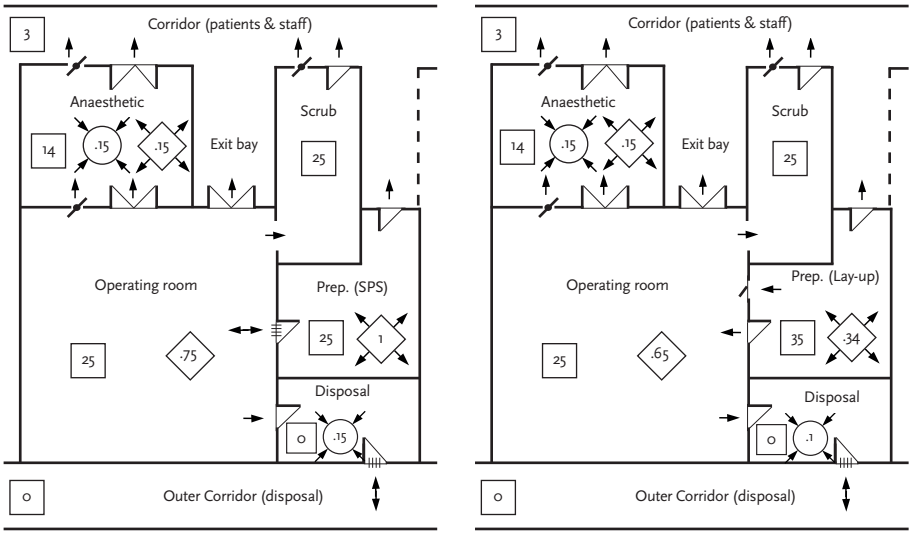


Figure 3: Comparison between the sterile pack prep and lay-up preps in HTM 2025

Plant control

In my experience, nearly all theatre plant requires some degree of adjustment from year to year – the challenge has always been minimising the amount of attention needed. Generally, other than basic cleanliness and compliance, issues fall into one of two categories:

- Control system design
- Ensuring high levels of maintenance.

The controls that manage the air system are of the utmost importance. In most cases, the control system regulates the air using some form of air volume sensing – typically a differential pressure transducer across an airflow metering station. Provided the sensor is maintained, it is possible to control the airflow to a high level of accuracy.

A good starting point is to use the main branch of the system for control and the sub-branches for feed-back. This allows the fans to respond to changing system characteristics and also shows how the performance is changing over time, ensuring the estates team is able to learn from, and effectively manage, these systems.

Control schemes that vary the fan speeds based on static pressure are not really suitable for operating theatres and should be avoided.

An example to illustrate this point is an operating theatre air handling unit (AHU) set out as per the diagram overleaf (see Figure 4).

When looked at in isolation, the AHU is suited to having variable speed drives (VSDs) on the supply and extract motors and the control signal derived from the generated pressure in the ductwork. As the internal filters are used over a period, it becomes more difficult to pass air.

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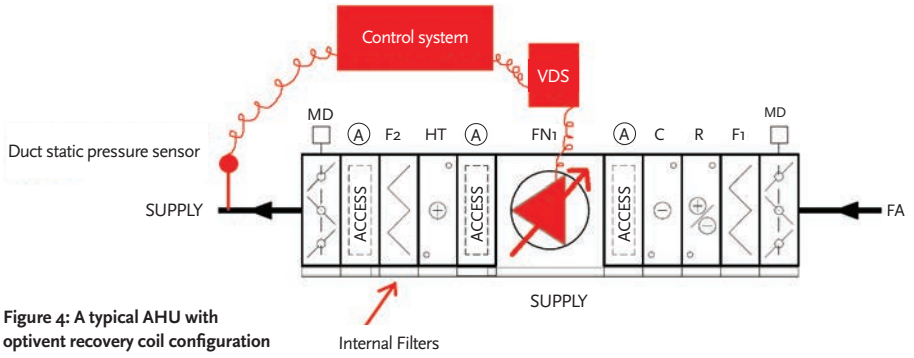

Figure 4: A typical AHU with optivent recovery coil configuration

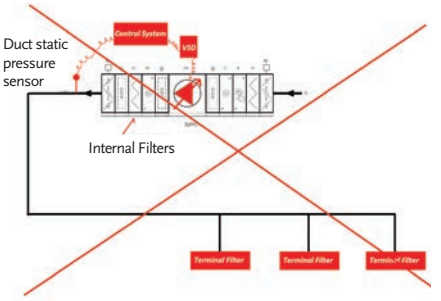

Figure 5: Unsuitable control via discharge static pressure with downstream filtration

Consequently, the measured static pressure will decrease and, if the building management system (BMS) is programmed to maintain a set point, a higher speed reference signal will be sent to the VSD, which in turn increases the plant to maintain its set pressure. Pressure is then balanced to the correct volume, and all is well. Or is it?

It is important to look beyond the AHU itself and consider the wider system. If the AHU is only connected to ductwork with no downstream filtration, then the control scheme might be adequate. This does not, however, take into account the ageing of ductwork (increasing resistance) throughout the distribution and also does not provide for any downstream filtration, which in many theatres is standard (Figure 5).

With a pressure-controlled AHU (with a static reading on the discharge side of the fan), as the terminal filters become spent and their DP rises, the fan in the AHU will slow, resulting in less than the required air. The best scheme employs volume/velocity measurement at multiple points and is able to schedule a volume set point from the BMS. Such a scheme will also allow the estates department to track the airtightness of their ductwork and plan effectively for preventative maintenance (Figure 6).

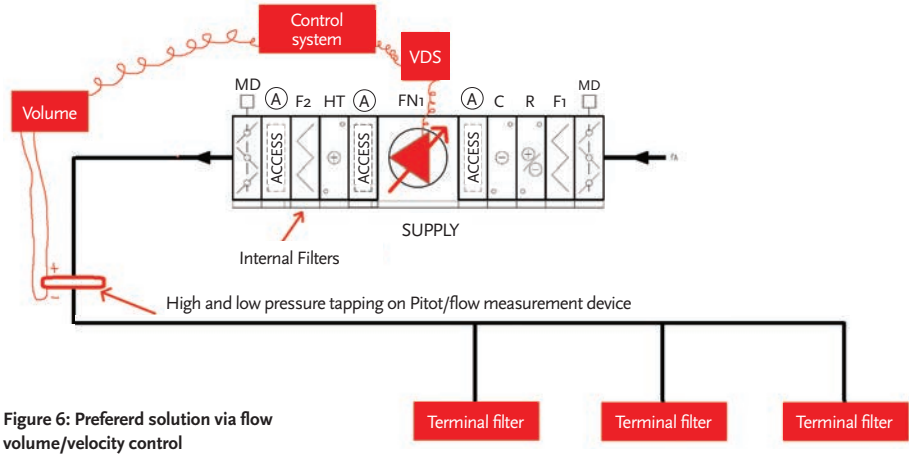

Figure 6: Prefererd solution via flow volume/velocity control

The future?

For theatre plant to work effectively, not only must the design be correct, but the installation should be maintained to a high standard. BMS controls should be verified by technicians who fully understand the intended operation. Proactive, rather than reactive, maintenance measures should be implemented.

There are still some areas of confusion for commissioning technicians. Is the air change rate made up of new air, or can it incorporate spill air from other areas (such as from the preparation room to the operating room)?

Also, air volume readings taken with an electronic airflow measuring device in room spaces are factorised, with the factor determined by the difference in read values at the ductwork test point and within the room. Future documentation should clarify this for the estates department.

It's important for the designers to be familiar with the relevant guidance – but it's equally important for guidance to be clear. **CJ**

References:

1 **HTM 2025 page 65 (plan 5b)**
2 **HTM 03 01 page 93**

JONATHAN PARADI CEng MCIBSE is senior authorised specialist (high voltage systems) at Crown House Technologies. He was senior engineer at Great Ormond Street Hospital for Children NHS Foundation Trust from 2008-2013

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Moving towards interoperability in building services control

This module examines the common protocols that are allowing building automation and control systems to converge

By integrating all levels of building services into building automation and control systems, widespread 'smart buildings' and 'smart cities' edge a little closer to reality. When system components such as water heaters – which have previously been marooned in their lonely control environments – are fully connected using the mature, open and interoperable systems, the possibilities go beyond simply meeting regulatory requirements, and towards the nirvana of 'smart energy grids'.

This CPD will consider examples of the common protocols that are allowing building automation and control systems (BACS) to converge, so enabling the means by which the information that drives 'smart cities' may be collected and communicated.

The core tasks involved in providing successfully interoperable BACS have long been established[1] as:

Data exchange – What data is required, and how fast and often it is needed; the requirement for control and optimisation of data; and what needs to be displayed and adjusted.

Alarms and events – From where alarms emanate; where events are logged and displayed; what indication is used, and how they are acknowledged; the information required from the alarm; and how it may be modified.

Schedules – For HVAC equipment that runs on schedule, how those schedules are read and modified.

Trends – The origin of the trend data; how it is transmitted and stored; how it will be processed and displayed (and where); and how the trend parameters may be modified.

Network management – The network diagnostic and maintenance functions that are required, and where they exist. Increasingly, the data access and security functions are a significant element of network management functions.

When assessing the suitability of a BACS, the list of core tasks makes a useful reference point. Although there is not always a clear breakpoint in the BACS hierarchy, there are three commonly applied terms that describe the influence of a particular protocol (see Figure 1):

Field level – Consisting of sensors and actuators. This is where the data is collected, and the final control takes place. Data typically passes in small packets, at frequent intervals.

Automation level – For room control and primary system control. Larger data transfers, aggregating the field level control and inputs with the control strategies, with cycle times of milliseconds/seconds.

Management level – For overall operation, monitoring and evaluation. This is the level where changes are made that may affect a whole system or automation sub-system. This may be undertaken locally to the system or, for example, through an internet connection. This requires a high data-exchange rate, as it potentially deals with data from the whole system.

For the various components in a building to communicate, there needs to be a language – or protocol – that allows components to share information in an effective and efficient way, both at, and between, each of the operating levels. The standards that often determine this in building automation and control are BACnet and LonWorks. These exist alongside others more associated with the automation and field levels – such as Modbus and KNX, and more niche protocols such as DALI (digital addressable lighting interface). Each of the standards has its own strengths, weaknesses and protagonists. However, there is an increasing opportunity for coexistence of these systems, with the converters – 'gateways' and 'bridges' – becoming more widespread as the cost of microprocessor technology falls. (This software interoperability should not be confused with day-to-day operation and maintenance at the physical field level, where there will still be challenges in component interoperability.)

Manufactured products for building services are often developed to incorporate control input/output through a particular protocol or

set of protocols. This will often mean that the manufacturer may have its own embedded controls within the core of the equipment, and then a bespoke integrated gateway to allow the interoperable network to access certain parameters. So, for example, the water heater in Figure 2 provides BACnet and Modbus access to 45 parameters, such as temperature setpoints, measured temperatures, water flow rates, fault diagnosis, and operating status. The gateway will convert those readings as defined by the specifically chosen protocol so that they can be accessed across the building automation and control system.

An overview of selected protocols used in building control systems

There are many protocols in use, and a proper explanation for each one could fill a textbook. The following is an overview of those that are seemingly most widely used (see suggested reading at the end of this article for more detail).

Since much of the work of building monitoring and control is converging with the business and enterprise networks, these control protocols will typically include – or have third-party additions for – internet services that allow the sharing of information, and interaction, with local and global networks. Any BACS that has a route to the internet must have robust and well-maintained network security.

Modbus was developed by Modicon (now Schneider Electric) and released in 1979. The standard was initially aimed at programmable logic controllers, and its biggest sector remains the industrial controller market. In 2004, it was transferred as an open standard to the Modbus Organisation, and is now freely available. The implementation of Modbus is relatively simple, requiring little 'specialist' network technology – it is a standard that many of the automation early users grew up with, and continues to maintain a large user base. Although not particularly aimed at building automation and control, the simple common messaging structure has attracted widespread adoption, using customised software interfaces. Modbus is able to work over ethernet media and the internet (as Modbus TCP/IP), but its fundamental design is such that, in the master/slave relationship, only the master can initiate a communication – the slave (for example, a temperature sensor or speed controller) would need to wait to be polled for its output. So, at the automation and field levels, it continues to be widely used. It is available in the control offerings of many different vendors to support automation and field-level connectivity.

KNX – which, in 1999, succeeded European Installation Bus, European Home System and BatiBUS – grew out of standards that aimed to allow home and office control systems to communicate readily through a dedicated network separated from power systems. Because of robust assurance procedures, KNX-certified products made by different manufacturers can be confidently combined, and this has made the application of this protocol particularly strong at field and automation levels. The provision, by KNX, of accessible manufacturer-independent design, configuration and operation software tools has helped to grow the protocol's popularity. At a local level, it often uses a simple twisted-pair cable for transmission. However, it can be used equally well over a wider range of media, including those in IP networks.

Figure 1: Levels of building control

LonWorks uses the LonTalk communications protocol that is held in the memory of the processor chip of every LonWorks-compatible device. LonWorks is a proprietary protocol developed by the Echelon Corporation, in conjunction with Motorola, in the early 1990s. Initially, this required a dedicated proprietary 'Neuron' chip – which also provided local control – but, since 1999, this is no longer a requirement, and other microprocessors with appropriate programming may be used.

The local operating network (Lon) collects together intelligent, independent products (nodes, such as boilers, valves or sensors), potentially employing a wide range of communications media that are then used to provide feedback and control. It can also be used over the internet. Processing capabilities and input/output in each node can undertake control action using input data and actuators, while also interacting with any other devices on the network using LonTalk.

LonTalk is a protocol that is optimised to transfer – reliably and swiftly – the short packets of information that are required in control and feedback applications. All devices on a LonWorks network must be 'bound' to each other – that is, set up to be known to each other – and, similarly, any gateway device that moves information between networks and protocols will only receive data from those devices it is bound to. All LonMark-marked products must have been verified to conform to the LonWorks protocol, and are offered by many manufacturers.

LonWorks has more than 210 data types – known as standard network variable types (SNVTs, pronounced 'sniv-its') – that define whether the data represent variables such as temperature, pressure, humidity, or counters to measure such things as on/off cycles, and in what format it will be offered across the network. These standardised variables have helped in maintaining and developing the success of LonWorks.

LonWorks spans all levels of control hierarchy, and is seen as being particularly strong at field and automation level.

BACnet was originally developed in 1987 through ASHRAE and has been an ISO standard since 2003. It enables interoperability between different building systems and devices – not providing the control logic, but supplying the means for communication and data handling. It is written specifically to allow interoperability between all HVAC devices, as well as with other building systems and devices, such as lighting, security systems, vertical

transportation, and access control.

Typically, each device – known as a BACnet object – is formed of a micro-based controller with specific software that links to the component (such as a water heater). Within that device there are standardised definitions, including a device number (unique within its local network) and a collection of information about the device, and any input and output points that it monitors and controls.

There are a number of services that may be included in the devices, which are grouped into: object access, alarm and event management; scheduling; trending; files; and device and network management. As well as the device number, a particular building automation device may include none – or many instances, of – these services. When used across IP networks, BACnet does not require the use of TCP, but utilises the faster UDP protocol.

As an open standard, BACnet may be employed by any manufacturer, and innovative evolution is encouraged. However, there is a standardised classification methodology that ensures the terms and format are understandable, so that devices may be specified in terms of their function. Optionally, devices may be tested as compliant with the BACnet standard, and awarded a BTL Mark.

BACnet provides services that transcend the management, automation and field levels, and is often used in combination with other automation and field-level networks because it has strong management and wide area-networking capabilities. BACnet relies on third parties to develop administration and design tools – many vendors provide impressive software offerings with their BACnet-enabled products. The BACnet specification is under continuous development through ASHRAE SSPC 135, representing all industry sectors.

Figure 2: Increasingly, formerly stand-alone systems – such as this water heater – are employing bespoke integrated gateways to provide connectivity and interoperability with standard network protocols

The interoperability of all these protocols is key for the proper operation of smart buildings. Practically – either through in-built processes or third-party devices – all these protocols may co-exist (at some level) to form an integrated BACS.

However, effective BACS is no replacement for robust, well-designed and controlled end systems. Manufacturers need to develop products with appropriate internal control software/firmware so the BACS can communicate with the vital operational parameters. So, considering a continuous-flow direct water heater, the combustion process may be closely controlled to optimise operation, but unless that information can pass to the management level – for example, through appropriate 'objects' or 'SNVTs' – opportunities for 'smart' operation may be limited.

As technologies – such as autonomous wireless sensing and product control interfaces – evolve, the BACS will have to be flexible and robust to maintain meaningful operation. Realistically, this might enable a water heater in the sports centre of tomorrow to aggregate feedback from internet-sourced weather forecasts, the number of customers on site, and the demand on local gas supplies – setting appropriate flow-water temperatures and combustion parameters to satisfy customers and make responsible use of resources.

Further reading:

CIBSE Guide H Chapter 4 , 2009.

BRE IP 1/07 *Internet Protocol: an introductory guide* is a good introduction to IP and associated terminology.

There is an interesting overview of practical experiences of protocols at **www.automatedbuildings.com/news/oct11/articles/andydavis/110925014909andydavis.html**

A more formal comparison is at **www2.ic.uff.br/iwssip2010/Proceedings/nav/papers/paper_49.pdf**

References:

1 Ehrlich, P. and Pittel, O., *Specifying interoperability*, ASHRAE Journal 41(4):25-29, 1999.

Turn over page to complete module

Key terms that underpin IP-based control protocols, with simplified explanations....

Ethernet. Ethernet is the most widely installed local area network (LAN) technology that provides the physical communication service. It reads and writes 'frames' of information through a medium (for example, twisted-pair cables or optic-fibre). The frame has a limited size, and includes the sending and receiving of MAC (ethernet medium access control) addresses (no two ethernet devices should ever have the same address). Ethernet supports all popular network protocols, and is principally used for IP.

Protocol. A special set of rules to allow communications between devices. These may be hardware rules (for example, the type of cable) or software rules (for example, the type of packet). Computers rely on protocols as humans do on language.

IP (internet protocol). This allows data sent from one computer to reach another across a network. Each device has at least one IP address that uniquely identifies it. IP 'packets' contain small amounts of information, and many packets are needed to send a complete message. For equipment to communicate on the internet, a second 'transport layer' protocol must also be used, such as TCP or UDP.

Packets (or 'datagrams'). IP data is sent in little chunks of data called packets. (Packets are carried in frames.) Each of these packets contains both the sender's and the receiver's address, plus other information. Any packet is sent first to a 'gateway' computer – or 'router' – that can relay the packet to its correct destination. If it is outside the local network (on an intranet or the internet), it forwards the packet to an adjacent gateway that, in turn, reads the destination address and so forth, until one gateway recognises the packet as belonging to a device within its immediate neighbourhood or domain. Successive packets may take different routes, with different travel times, and some may not make it to the destination at all.

TCP (transmission control protocol) is a protocol used with IP to send data in packets between devices. By first setting up a connection between the sender and receiver, it provides end-to-end reliability, sequencing (of packets arriving in a random order) and flow control. Whereas IP takes care of handling the actual delivery of the data, TCP takes care of keeping track of the individual packets of a message.

UDP (user datagram protocol) works with IP without first setting up a sender-to-receiver connection, and passes 'datagrams' – self-contained, independent entities of data, each with sufficient information to be routed from the source – to the destination. It readily performs the use of 'one to many' messages (unlike TCP). It is used by applications that require speed, and do not require the level of service of TCP (the applications do the control/checking themselves). It is particularly useful where short – and possibly independent – messages are being conveyed.

Module 68
September 2014

1. Which of these is probably not included in the basic core tasks for a successful interoperable BACS?

- ☐ A Alarms
- ☐ B Data exchange
- ☐ C Network management
- ☐ D Proportional control algorithms
- ☐ E Trends

2. Which of these protocols is particularly used for lighting systems?

- ☐ A BACnet
- ☐ B DALI
- ☐ C KNX
- ☐ D LonWorks
- ☐ E Modbus

3. When was BACnet originally developed?

- ☐ A 1979
- ☐ B 1987
- ☐ C 1990
- ☐ D 1999
- ☐ E 2003

4. How many parameters are monitored through the gateway described for the example water heater?

- ☐ A 5
- ☐ B 15
- ☐ C 25
- ☐ D 35
- ☐ E 45

5. Which of these is most likely to exist at the 'field level'?

- ☐ A Computer with management software
- ☐ B Intelligent gateway
- ☐ C Intelligent outstation
- ☐ D Temperature sensor
- ☐ E Wireless gateway

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Electric heating at top tourist attraction

Atlantic Boilers of Oldham have installed an electric combination boiler at Edinburgh Castle. The castle is the most visited paid-for tourist attraction in Scotland and is maintained by Historic Scotland. The boiler is tucked away in a convenient corner and there are no problems with noise or pollution, and there is no necessity for chimneys. The Atlantic HBI-S20 electric combination boiler meets the radiator heating and hot water needs for the historical building and gives precise control and easy installation. The boiler serves loads from 6 kW to 27 kW and can vary the mix of loads between space heating and domestic hot water. In August, Edinburgh Castle hosts the Royal Edinburgh Military Tattoo and the activities at the castle extend throughout the year, therefore economic boilers are always required.

Call 0161 6215960, email nabeela@atlanticboilers.com or visit www.atlanticboilers.com

High bay KNX detection from CP Electronics

CP Electronics, the UK market leader in lighting controls, has launched the EBDHS-KNX, a high sensitivity PIR suitable for high bay luminaires. As part of the new KNX range, the sensor provides the end user with scene recall, dimming and constant brightness control, all via a-simple-to-use logic controller. Main features of the KNX range of PIRs include two switch inputs, programmable logic block, full scene setting via a handset and set up via KNX ETS software.

Call 0333 9000671, email enquiry@cpelectronics.co.uk or visit www.cpelectronics.co.uk

PCM offers thermal solution

Phase Change Materials (PCMs) are ideal products for thermal management solutions. This is because they store and release thermal energy during the process of melting and freezing, in the exact same way an ice cube maintains a prolonged cooling effect in a glass of water. This very simple concept enables a bridging of the gap between energy requirement and energy use. When applied correctly, PCMs can offer free cooling, increased efficiency and lower system running costs. PCMs between 8-20°C can be simply charged using a free cooler over-night without the use of a chiller and later the stored free energy can be used to handle the day-time sensible building loads.

Call 01733 245511, email info@pcmproducts.net or visit www.pcmproducts.net

CP Northern supplies control system for the University of Hull

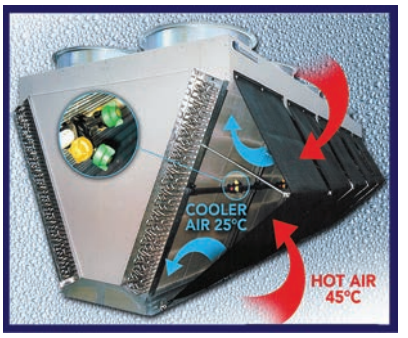
CP Northern has supplied a bespoke control system for the newly refurbished Brynmor Jones Library at the University of Hull. The system controls lighting, ventilation fans and water solenoids, helping to minimise the building's environmental impact and running costs. As the building comprises two towers, CP Northern configured the backbone of the control network to run up the East Tower first before returning nd ascending the West Tower. The system uses DALI-based control for new and existing light fittings.

Call 0845 0755884, email sales@cpnorthern.co.uk or visit www.cpnorthern.co.uk

Adiabatic air inlet cooling

EcoMESH is a unique mesh and water spray system that improves the performance of air cooled chillers, dry coolers and refrigeration plants while reducing the energy consumption by up to 44%. EcoMESH has been fitted to troublesome units worldwide, where its patented water spray technology eliminates problems and, once fitted, is virtually maintenance-free. It can be retrofitted to any model, make or size of air conditioning and refrigeration unit.

Call 01733 244224 or visit www.ecomesh.eu



GE shines a light on priceless art

The Beaney House of Art & Knowledge, Canterbury's central museum, library and art gallery, has recently undergone a £14m restoration project, which included GE Lighting's products in an LED upgrade.

Chosen for its advanced flexibility and efficiency, GE Lighting's Infusion Generation 3 LED module was installed throughout the building, offering significant annual energy savings and reduced maintenance costs. The modules are capable of being individually adjusted, offering a range of beams that can be sensitively dimmed for multiple purposes.

Call 0800 1698290 or visit www.gelighting.com

PRODUCTS & SERVICES

Telephone: 020 7880 7614 **Email:** Patrick.Lynn@redactive.co.uk

Polypipe's ducting system used in marina development

Polypipe Ventilation's Domus rigid duct and unique Domus Thermal duct insulation systems are being installed into an exciting new mixed-use development in Southampton's marina, which aims to provide the city with a world-class waterfront destination.

Domus Supertube is a highly engineered flat channel ducting system, which as with all Domus duct products, is manufactured to exacting tolerances, which virtually eliminates air leakage and minimises the pressure drop associated with ducting systems.

Call 08443 715523, email vent.info@polypipe.com or visit www.polypipe.com/ventilation

Ideal Commercial boilers appoint new manager

Simon Carpenter has joined Ideal Commercial Boilers in the role of specification manager, expanding the company's growing team of consultative technical experts and further strengthening Ideal Commercial's position as a commercial heating solutions specialist. Simon's role will entail working closely with major consultants, specifiers and contractors in the Central London area to assist in the selection of boiler plant and suitable equipment for a whole host of commercial and residential applications, including schools, hospitals, hotels, retail outlets and large scale communal heating developments.

Call 01482 492251, email commercial@idealheating.com or visit www.idealcommercialheating.com

Remeha expands sales team

Remeha Commercial has appointed Ray Lloyd as area sales manager for the North West region. Ray brings extensive knowledge of the heating industry and a wealth of sales experience gained from previous roles at Lochinvar and ACV. 'We're delighted that Ray has joined our expanding sales force,' said Mark Northcott, managing director at Remeha Commercial. 'He is a welcome addition to our experienced, knowledgeable team with its unrivalled reputation for excellent service throughout the building services industry.'

Call 0118 9783434, email boilers@remeha.co.uk or visit www.remeha.co.uk

Air Design supplies AHUs for golf club

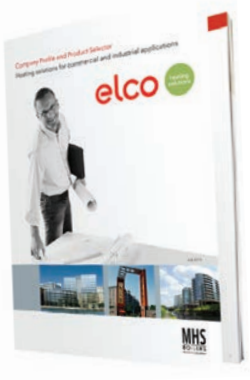
At the prestigious Renaissance Club, one of the newest golf courses in Scotland, four innovative air handling units supplied by Air Design are recovering heat in the clubhouse.

Air Design, part of the Elta Group of companies, supplied the air handling units to mechanical and electrical engineering contractor, Vaughan Engineering, for use within the newly constructed clubhouse. Three of the units were fitted with high efficiency thermal wheels to recover as much heat as possible from the internal space.

AHUs from the Air Design range are technically efficient, combining quality component parts with simplicity of design and construction.

Visit www.air-design.com

New product selector from ELCO UK



To coincide with the introduction of numerous heating, hot water and renewable products, leading manufacturer ELCO UK (formerly MHS Boilers) has produced a new, all-encompassing product selector catalogue.

Consisting of 88 pages, it features the complete portfolio of the company's products and is designed as a 'one stop shop' for specifiers and building services engineers.

Standout additions to this year's Selector include the new Aeropur CRX air source heat pump , the wall-mounted Thision S boiler, and the Vistron HP hot water cylinder.

Visit www.elco.co.uk

Keraflo launches enhanced water tank control system

Keraflo, manufacturer of 'Aylesbury' float valves and tank management systems, has launched an enhanced user-friendly version of its digital water tank control system Tanktronic, which boasts an array of new functionality. It provides a cutting-edge solution for buildings with water tanks to service a big reserve of water, including hospitals, hotels and office buildings. It allows users complete control over their water stores.

Call 0118 9219920, email info@keraflo.co.uk or visit www.keraflo.co.uk

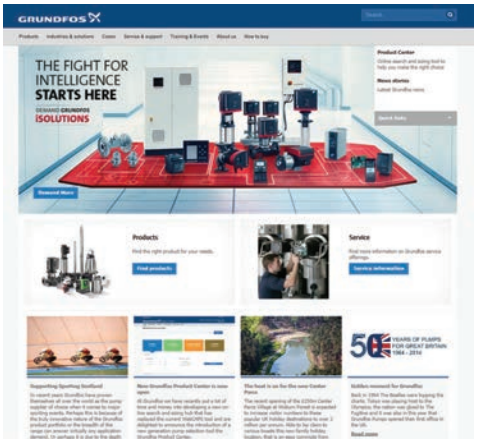
ABEC in partnership with delta controls

Automated Building & Energy Controls (ABEC) has entered into a partnership with building controls manufacturer, Delta Controls. The partnership reflects the key role building controls have in driving efficiency for clients' cost and carbon savings. As a supplier of Delta Controls, ABEC will offer building control solutions to commercial, government and retail clients, as well as schools, universities, hospitals and airports. Delta systems enable clients to have a single point of control for internal building services such as HVAC, lighting and access. Andrew Dyke, technical director of ABEC, said: 'Our partnership with Delta Controls allows us to offer a wider, more flexible choice of energy management solutions to suit our clients' needs and further highlights our focus on the integral role of energy in building performance.'

Call 01684 853780, visit www.abec.co.uk or follow @ABEC_UK

Delta™ CONTROLS

Grundfos website hits the right notes



With a loyal following of new and returning visitors each month, the Grundfos website is a popular communication hub for those seeking information on new and/or replacement pump solutions.

There are many good reasons for this popularity, including that it is now easier to find a specific product, locate support data and quick links to a wide range of campaign-specific sites.

There is a major emphasis on the significant amounts of energy that can be saved simply by fitting the correct pumps. In addition, there is a section towards the bottom of the home page that provides information on case stories, product updates, industry news and other relevant updates all of which mainly relate to the UK market. This communication hub – that is updated regularly – has become one of the most popular areas of the site.

● **Call 01525 850000, email grundfosuk@grundfos.com or visit www.grundfos.co.uk**

Axair provides powerful protection from hazardous fumes

Designed for exhausting fumes from hazardous manufacturing processes, the SEAT S50 fume extraction fan is the latest addition to SEAT's S Series and can support perilous processes such as PCB manufacturing, component washing and etching.

Fitted with a backward curved impeller, the S50 can produce a high pressure, but with low noise and impressive efficiency. The fan's polypropylene construction makes it ideal for use in highly corrosive environments and chemical industry applications, safeguarding workers from potentially harmful gases.

● **Call 01782 349430 or visit www.axair-fans.co.uk**

CIBSE-approved pre-insulated ductwork CPD seminar from Kingspan

Kingspan Insulation has introduced a new CIBSE-approved CPD seminar examining how the Kingspan KoolDuct system of pre-insulated ductwork can help reduce building services costs and ease compliance with the latest regulations. The CPD incorporates a live case study highlighting how the superior airtightness and thermal performance of the Kingspan KoolDuct System can deliver substantial energy savings and reductions in CO_2 emissions across a building's lifespan.

● **Call o 1544 387 384 , email presentations@kingspaninsulation.co.uk, fax 01544 387 484 or visit www.kingspaninsulation.co.uk**

Kingspan Tarac unveils the new Kooltherm® FireSleeve

Kingspan Tarec® has unveiled Kooltherm® FireSleeve, a slim solution which expands to several times its normal size in the event of fire, helping to seal service penetrations and reinstate the original fire rating of a building element. The Kooltherm® FireSleeve comprises an intumescent layer inside a stainless steel facing and is sealed at both ends with compressible rings. When exposed to high levels of heat, the intumescent swells and forms a hard char, which closes gaps between the pipework and the penetration edge. The product achieves a two-hour fire integrity rating to BS EN 1366.

● **Call 01457 890400, email info.uk@kingspantarec.co.uk, fax 01457 852319 or visit www.kingspantarec.com**

JS launches Essensse air curtain

JS Air Curtains has launched Essensse, an attractive and economic air curtain suitable for a range of environments from small shops and restaurants to office buildings and banks.

Essensse can deliver up to 2,900 m³ of air, enabling it to seal doorways up to 2.5 m high when mounted above an entrance. Easy to install, the compact unit is finished in white RAL 9010 as standard with other colours available on request.

● **Call 01903 858656 or visit www.jsaircurtains.com**

Mikrofil at Kenbrook nursing home

Kenbrook nursing home provides 24-hour specialist nursing and dementia care for more than 50 residents in the residential area of Wembley Park, North London.

In need of a new heating and hot water installation, Mikrofill provided three Ethos 130 kW condensing boilers c/w Mikrovent low-loss header/air and dirt separator and one unvented 500 litre Extreme HWS loading cylinder. The new boilers provide heating throughout the building in addition to indirect LPHW to the cylinder.

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

Nuaire announced as National Business Awards finalist

Ventilation manufacturer Nuaire has been nominated for the Market Gravity Innovation Award in the 2014 National Business Awards. Going up against high profile companies including British Gas and Heathrow Airport, Nuaire will compete for the prestigious award at a gala dinner held on 11 November at Grosvenor House Hotel, London.

Marketing director Andy Mudie said: 'The XBOXER XBC is our market-leading commercial heat recovery range that is taking the building services industry by storm.'

● **Visit Nuaire at www.nuaire.co.uk**

PRODUCTS & SERVICES

Telephone: 020 7880 7614 **Email:** Patrick.Lynn@redactive.co.uk

Adams Rite supplies Sentinel M locks to engineering centre

Adams Rite, part of Assa Abloy Security Solutions, has supplied its new commercial multipoint lock to Norfolk-based Hethel Engineering Centre, which has developed more than 70 start-up businesses since 2006. JPJ Installations, of Braintree, Essex, integrated Sentinel M panic locks within Kawneer door sets, offering the centre's tenants the reassurance that the units they rent are securely locked, and their assets protected. A range of accessories, including panic exit devices, supports the Sentinel M range. All panic locks are CE marked and tested to EN 1125 with additional hardware.

● **Visit www.assaabloy.co.uk/securitysolutions**

KNX assists at Hereward College

KNX intelligent building technology has been implemented as the platform for the environmental controls at Hereward College, in Coventry, to help students access facilities and services provided.

KNX's environmental control (EC) units were fitted into some existing residential rooms, providing an easy, independent means of operating various appliances from televisions and Hi FI equipment, to doors, windows, curtains/blinds, lighting, and room temperature.

● **Call 0845 869 5908 , email admin@knxuk.org or visit www.knxuk.org**

Titan Products' TPZ-NET wireless CO_2 range expands

Two wireless CO_2 sensors launched by Titan Products include the TPZCO_2T/L, which now adds LED indication for CO_2 while maintaining a strong battery life of up to three years. The CO_2 sensor is completely wireless and battery driven. The second product is a CO_2 indication-only sensor, the TPZCO_2/IND. This is designed for applications that do not require any automated control and indicates when the CO_2 levels are becoming high.

● **Call 0161 4066480, email admin@titanproducts.com or visit www.titanproducts.com**

Bosch launches heat recovery boiler

Bosch Commercial and Industrial Heating, has introduced a new heat recovery system, designed to operate in conjunction with combined heat and power modules, as well as other industrial heating systems.

The new Heat Recovery Steam Boiler (HRSB) boasts the ability to generate between 400 and 4,100 kg of effective process steam per hour and provides an efficient way of converting accumulated heat in flue gases generated from combustion at a downstream CHP module.

● **Call 0330 1233004 or visit www.bosch-industrial.co.uk**

Remeha keeps it warm at RSH+P's Riverlight

Four Remeha Gas 610-8 section boilers are providing energy-saving heating at Riverlight, the new 806-apartment development designed by architects Rogers Stirk Harbour + Partners on London's South Bank. The 'renewable-ready' Remeha boilers, which operate alongside ground source heat pumps, were specified and installed by Rotary Building Services Ltd (Southern) to meet the brief by property firm St James for high efficiencies and low carbon and NO_x emissions. Rotary's operations director Len Quy said: 'We specified Remeha boilers due to their quality, energy rating compliance, reliability, and ease of installation and maintenance which has been matched by their excellent service.'

● **Call 0118 9783434, email boilers@remeha.co.uk or visit www.remeha.co.uk**

Diffuser is slot on

New linear slot diffusers from British manufacturer Air Diffusion have been designed to combine good looks with high performance. The Model Slot doubles can handle high air change rates to maintain indoor air quality and comfortable temperatures for building occupants. It is designed for maximum flexibility in air pattern and volume control; and is suitable for either ceiling or sidewall applications in a wide range of commercial building types. It is available in two slot widths – 20 mm and 25 mm – and eight slot sizes.

● **Visit www.ruskinuk.co.uk**

PRODUCTS & SERVICES

Telephone: 020 7880 7614 **Email:** Patrick.Lynn@redactive.co.uk

Kosnic design and efficiency in UK-manufactured luminaires

Kosnic, an established global manufacturer of LED lamp and luminaire technology, is pleased to announce the launch of its first UK designed and manufactured LED fitting – the new Kurve modular luminaire range. Including a premium LED module with Samsung LED chip and LED driver, the Kurve range has been fully developed in house by the Kosnic Technology Centre, guaranteeing high-quality, steady, flicker free light for both new and retrofit applications.

● **Call 0845 8386851 or visit www.kosnic.com**

Staying calm about noise

With public consultation on new acoustic regulations for schools now closed, specifiers are being reassured about potential changes. BB93 section 1 is going to be superseded by the Acoustic design for Schools: Performance Standard as driven by the Department for Education.

Gilberts of Blackpool, one of the UK's leading independent natural ventilation manufacturers, are ensuring that any refining of its acoustic testing both in-house or from external verified test centres remains compliant to the newly proposed document.

● **Call 01253 766911 or email info@gilbertsblackpool.com**

Ecodan controller from Mitsubishi Electric

Mitsubishi Electric has released a new Ecodan controller for situations where the renewable heating needs to interface with third party equipment or BEMS (building energy management system) controls.

The FTC2B Ecodan Controller brings the possibility of renewable heating to even more applications such as agricultural and shed heating, swimming pools and leisure centres, industrial process heating and under soil heating.

A combination of volt-free and voltage inputs allow third-party control systems to control multiple modes and flow temperatures of any model in the Ecodan PUHZ range. Unit running, defrost and error functions can also be monitored.

There are a huge number of commercial situations which are now eligible for the Non-Domestic RHI, and this controller enables business to take advantage. The Ecodan range offers capacities from 4 kW to 960 kW with either air or ground/water source options available. Mitsubishi Electric has designed Ecodan to work on its own or with existing gas or oil boilers.

● **Visit http://ecodanselectiontool.heating.mitsubishielectric.co.uk**

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St.Helens Council

Job Vacancy

www.sthelens.gov.uk/jobs

Senior Engineer (Mechanical)

Salary: **From £33,128 - £34,894**
Reference: **URAM36**
Grade: **SCP 39-41**
Department:
Urban Regeneration, Housing & Culture
Hours: **37 per week**
Closing date: **22 September 2014**

St Helens Council is looking to appoint a Senior Mechanical Engineer to join its Building Services Engineering Section. The role covers the design and contract supervision of mechanical design services, and the management of statutory maintenance contracts appertaining to mechanical services installations and plant.

You are expected to demonstrate experience in the use of AutoCad and computer aided design packages for mechanical services. The position also requires the candidate to have a proven track record in the management of statutory compliance requirements for the maintenance of boiler and air handling plant, together with the management and control of Legionella.

You will join the building services section of a multi-disciplinary Division that also includes a small architect's section, building and quantity surveyors, estates management and surveyors and education client property officers. The Division also provides a help-desk for schools and other clients.

St. Helens Council prides itself in the quality of the support its technical staff provide to schools and other clients. As a result, the building services section supports not only the LA controlled schools but also schools in the Aided Sector and Academies. In addition to education work, you will be working on the Authority's portfolio of public buildings including leisure centres, libraries and offices.

You are expected to be working towards chartered status.

For an informal discussion, please contact Frank Kelly on 01744 676454.

For further details and to apply, visit **www.sthelens.gov.uk/jobs**

Alternatively, you can contact **Scott Mather** via **01744 676322**, email: **CX@sthelens.gov.uk** or **Human Resources, Town Hall, Victoria Square, St Helens WA10 1HP.**

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blueprint recruitment

Principal Electrical Engineer | Various Locations | to £65K + Bens | ref: 6106
One of the leading multi-disciplinary engineering consultancies are seeking a Principal Electrical Engineer to lead the design team on a number of major projects including international developments. Generous package and benefits offered.

Junior Electrical Engineer | London | to £33K + Bens | ref: 6092
A busy contractor in the rail industry is seeking an ambitious engineer to join their thriving team. The ideal candidate will be keen to develop experience within the rail industry and be proficient using Amtech & Dialux. With opportunities for career progression, this is the ideal role for someone looking to further their career.

Thermal Modeler | Various Locations | to £45K + Bens | ref: 5671
Following an exceptional first half of 2014, our client is seeking a talented Thermal Modeler to join their successful team. You will assist with low carbon design solutions in relation to new and existing residential buildings. This role will suit dynamic individuals with an understanding of thermal modeling software including IES.

Senior Electrical Engineer | London | to £40 per hour Ltd | ref: 6100
A large multi-disciplinary building services consultancy is looking for an experienced Electrical Design Engineer. The successful candidate will be working on a major commercial project.

Mechanical Design Engineer | London | to £34 per hour Ltd | ref: 6081
Our client is a large global engineering consultancy looking for an experienced Mechanical Design Engineer. With a focus on sustainable projects within the commercial, residential and leisure sectors, you will lead developments across the UK.

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We're aiming to be in the top 10% in everything we do. To get there, we've recently set in motion a major restructuring exercise so that our organisation better reflects patient pathways – that's the way in which people use our services. We've made some significant changes to our senior management team and we now need an exceptional individual to help us deliver change and achieve our ambitions. If you can lead, motivate and inspire people to deliver great services, we would love you to join Team DBH.

Supporting Matthew, our Director of Finance and Infrastructure, you'll be a highly skilled professional who will shape the future for the Trust's site. A strategic thinker, you'll have chartered status in this area and be responsible for the statutory and regulatory framework for the Trust estate. With a track record in delivering capital programmes and integrating estates and facilities, you will also be an excellent people manager who leads by example. You'll be responsible for an annual revenue budget of £28m and some 800 people.

We're prepared to invest well to find the right person, with a senior manager contract on offer of up to £90k, depending on your experience and skills.

For an informal discussion, please ring 01302 36666 and ask for Matthew Lowry on extension 4119 or Nigel Myhill on extension 3943.

To find out more and apply, visit www.nhs.uk and search for DBH.

Closing date: 2 September 2014.
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Contract Senior Mechanical Design Engineer
London
£40 per hour Ltd
The globes leaders in the Building Services Industry are looking for an equally matched Mechanical Design Engineer to join their team on the largest UK project to date. Experience on large scale prestigious projects within a busy building services environment is essential. The contract offered is for a minimum of 12 months.

Electrical Design Engineer – Contract
City of London
£40 per hour Ltd
A Senior Electrical Design Engineer with over 4 years' experience at this level is required to join one of the UK's top 5 Building Services Consultancy. You will be working on an exciting new head office for a globally known commercial figure. The contract is for 6 months initially with another project in the pipeline already being discussed.

Associate Director – Sport Stadiums
London
£70,000 + Benefits
A large international MEP Building Services practice are currently looking for an Associate Director to lead a team of Engineers specialising in national and International stadiums. This practice is known to be the "go to" building services firm for stadiums, and as a result they now want to create a division devoted to this. Candidates should have experience leading teams and working on large international projects.

Associate Director
Glasgow
£60,000 + Benefits
We are currently looking for an Associate Director to join one of the largest engineering consultancies In the world. This is a great opportunity to work within a fully autonomous role, leading an entire building services office. Candidates will have experience leading project teams and be a Chartered Engineer.

Senior Electrical Engineer
Liverpool Street, London
£45,000 + Benefits
A rapidly expanding building services consultancy, who currently employ 25 engineers, is looking for an energetic electrical design engineer to work on commercial and residential projects in Central London. This is a fast paced and exciting place to work due to the expansion of the company. As the company grows and evolves, candidates will have the opportunity to climb the promotional ladder quickly.

Associate Sustainability Consultant
London Bridge
£60,000 + Benefits
A well-known multi-disciplined engineering consultancy in London is currently looking for a Principal Sustainability Consultant to join their expanding specialist department. Candidates will be experienced working within a consultancy environment, and have a passion to promote sustainability and energy reduction within the built environment. This is a great opportunity to join this expanding division and help drive forward their work ethos.

Lead Mechanical Design Engineer
Heathrow
£55,000 + Benefits
A large MEP Design practice is currently looking for a Mechanical Engineer to lead aviation projects and small teams in West London. This is a great time to join a practice whose recent framework wins have resulted in the need to grow the business. Engineers should have experience managing more junior engineers and technicians, and have experience working on aviation type projects.

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For more information about any of these positions, please contact **george@conradconsulting.co.uk** or call **0203 1595 387**

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Senior Electrical Engineer

£42 - 50k + benefits, London

A market leading multi-disciplinary consultancy with a rich history of engineering excellence and a project portfolio located across the globe require a Senior Electrical engineer to join their team in London. Aside from an outstanding list of current and pipeline projects, the company can offer a clear and defined career path. BAR1759/JA

Senior Fire Engineer

£60 - £70K + benefits, Croydon

Working for a specialist consultancy and leading a team of engineers in specifying appropriate fire protection measures on iconic building projects you will report in to the board of Directors. With at least 6 years' experience working in a consultancy you will play a key role in the development of the company. Preferably Chartered or a member of the IFE and be proficient with fire / smoke / evacuation modelling. BAR2096/CB

Senior Electrical Design Engineer

£33ph - £35ph, Central London

Immediate requirement for a contract Senior Electrical Design Engineer to work with an International Consultancy with a great reputation specializing in the stadia, commercial, healthcare and pharmaceutical sectors on a rolling contract. With continuous project wins, they need an engineer that is committed and able to work under their own initiative with minimum supervision. BAR2100/NA

Public Health Engineer

£35 – £42 p/h, London

Are you interested in a stable 3 year contract? Would you like to work on some of the world's most Iconic projects including a 7* Hotel? If you are looking for the flexibility of a contract role and would still like to be treated like a permanent member of staff within an organisation looking to double in size due to workload, you need to contact us ASAP! BAR1965/MA

Senior Mechanical Design Engineer

To £80k + benefits, Singapore

An exciting opportunity has arisen for a Mechanical Design Engineer to join an emerging global consulting engineering company in their Singapore office. This firm is a unique consultancy, specialising in design and specification of information technology and critical facility services. The ideal candidate must be able to demonstrate industrial design experience within the Data Centre sector. BAR2083/PA

Senior Mechanical Design Engineer

£30 - £35 p/h, London

We are working in partnership with one of the UK's largest M&E Consultancies in their search for a Senior Mechanical Engineer for a minimum 6 month contract. To be considered for this role applicants must come from a Building Services background and have experience working on high end residential projects. BAR2094/WS

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A UK top 10 M&E Contractor requires HVAC Project Engineers and Electrical Project engineers to work on multi £m Projects in Central London. Permanent or long Term Temporary Contract positions are available for Data Centre and High-Rise projects. **Contact:** darren.warmington@bsvrecruitment.co.uk

Mechanical & Electrical Design Engineers

Kent, Surrey & Sussex | £45-55k & Benefits | Refs: 14446

Various Building Services Consultants based outside of London are seeking to recruit Electrical & Mechanical Design Engineers to work typically on Residential, Commercial and Healthcare Projects. Working closely with Associates / Directors you will be able to work unaided and offer support to Junior members of the Design teams. **Contact:** michael.vieira@bsvrecruitment.co.uk

Intermediate Electrical Design Engineer

London | £35k + Benefits | Ref: 14713

This practice is a highly professional award winning consultancy, who are specialists in M&E Design as well as Sustainability. They are looking to add an Electrical Engineer to their fold. Working very closely with the Directors, this is a great opportunity to gain a large amount of experience on various projects taking them from the conception to handover. **Contact:** matthew.baker@bsvrecruitment.co.uk

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BIM THERE, DONE THAT

Beverley Clifton Morris is committed to the training and development of staff, investment in BIM processes, and low-carbon building solutions. Managing director, **Brian Morris**, explains what drives the business

Manchester-based Beverley Clifton Morris (BCM) – which won the 2014 CIBSE Building Services Consultancy of the Year (up to 100 employees) Award – specialises in low-carbon building services design. By providing early objective data, BCM allows the optimum design solution to be selected at the earliest stage of the process. BCM has an in-house graduate training scheme, and hopes its partnership with Liverpool John Moores University will result in innovative procurement methods and the creation of low-carbon jobs.

Why is it important to invest in staff training and development?

Our ethos is to develop low-carbon solutions from first principles, so the ability to design from sound engineering principles is key. Because of our specialist approach, we have always had a strong commitment to training and development. Our ability to train staff and create job opportunities gives us a competitive advantage when we are endeavouring to consolidate our positions on frameworks.

How does your bespoke BIM software help clients to make a decision?

We use detailed dynamic simulation modelling (DSM) to enable option appraisals for the building fabric and the building services as a whole at RIBA Stage 2. We optimise the capital cost, and inform the client – and other members of the design team – of the costs in use, and the overall life-cycle costs. This helps the team refine the design, because it informs them, objectively, of the implications of their decisions. They can then move forward to the detailed design stage, confident that the project objectives have been incorporated. We link the DSM with Revit models, using our BIM capability and processes, which enables efficiencies to be gained through the design and construction stages. This process is proven to reduce abortive design and redesign works.

> If a building is designed effectively, low-carbon, energy-efficient buildings don't need to have a higher capital cost

Which project has been the most rewarding?

Recently, we have achieved eight BREEAM Excellent and seven BREEAM Very Good ratings.

The most significant project for the development of the business was Park View Community Primary School, Greater Manchester's first EPC A-rated primary school. The carbon emissions were a 53% improvement on the Building Regulations requirement, and 55% of the energy is delivered via on-site renewable sources.

Wyke Sixth Form College (pictured) was another notable success. We improved the energy efficiency of the building at RIBA Stage 2, achieving £250,000 of savings in bore holes for the ground source heat pump solution alone. If a building is designed effectively, low-carbon, energy-efficient buildings don't need to have a higher capital cost.

How do you ensure you keep to a project's design principles?

We undertake DSM and the initial BIM 3D design at Stage 2, so we are able to significantly de-risk the project.

Communication is key, and we spend time with the design team and the client at Stage 2 to ensure they understand the implications on the ultimate performance of the building. We also spend time with the structural engineer at this point, integrating the strategic services and the proposed structural solutions. By reducing project risk early on, there is less chance of the design drifting at a later stage.

How do you encourage your clients to use soft landings?

Some Education Funding Agency school contracts have contractual requirements for soft landings. CarbonBuzz and iServ are the tools used. While the construction industry is getting systems in place to meet the 2016 BIM criteria, there has been less focus on soft landings requirements, which kick in at the same time. We try to educate our clients about what it could equate to in reduced life-cycle costs.

How are you closing the performance gap?

We encourage our clients to manage their buildings and their energy consumption properly on a 'day +1' basis.

We can adjust the Stage 2 DSMs to run as calibrated models. This enables us to set energy and carbon targets based on the initial design. Our engineers do surveys and reviews of building information – including DECs and CarbonBuzz – to see how the building is actually operating. Through this, we identify the areas where there is high, or unexpected, energy use.

As we encourage more clients to populate tools such as CarbonBuzz and iServ, we are obtaining more information about how our buildings are operating.

● **BRIAN MORRIS** MCIBSE is managing director at Beverley Clifton Morris.

Events & training

NATIONAL EVENTS AND CONFERENCES

4th Symposium on lift and Escalator Technologies
25 & 26 September, Northampton
Bringing together experts from the field of vertical transportation.
www.liftsymposium.org

Young Engineers Awards
9 October, London
The winners of the Graduate of the Year Award and the Employer of the Year award winner are unveiled.
www.cibse.org/yea

Leadership in Building Performance
28 & 29 October, London
A major new conference and exhibition looking at efficient design, construction, maintenance and operation of buildings, and the systems that support them.
www.cibse.org/conference

CIBSE GROUPS, REGIONS AND SOCIETIES

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

Artificial Light at Night Conference (ALAN)
4 September, Leicester
ALAN14 Conference, supported by the Society of Light and Lighting.
www.cibse.org/events

ANZ Region – Western Australia: Commercial/ Naval Ship Engineering Services
9 September, Perth
The latest in a line of bi-monthly seminars arranged by the Western Australia chapter
www.cibse.org/events

East Midlands Region: Asbestos – Changes to legislation
9 September, Northampton
Presentation by Stephen Shutler covering the changes to asbestos legislation and guidance.
www.cibse.org/events

WiBSE Peer to Peer Mentoring Programme. What obstacles are holding you back right now?
10 September, London
Continuing the WiBSE mentoring programme
www.cibse.org/events

YEN North West Region: Air Source AHUs Factory Visit
11 September, Manchester
Learn about the design and manufacture of air handling unit components with our trip to Air Source Ventilation in Eccles.
www.cibse.org/events

Merseyside & North Wales Region: CHP Utilisation
11 September, Merseyside
An evening seminar.
www.cibse.org/events

ANZ Region – South Australia: Thermal Imaging
11 September, Adelaide
The latest monthly seminar arranged by the South Australia chapter.
www.cibse.org/events

Accounting for Human Activity in the Design, Prediction and Operation of Buildings
12 September, Sheffield
Seminar presenting overview of current research into how building occupants affect building performance.
www.cibse.org/nvg

Ireland Region: CIBSE Golf Outing 2014
12 September, Dublin
Team competition at Castleknock Golf & Country Club.
www.cibse.org/events

WiBSE London Role Model Series
16 September, London
Continuing the role model series for Women in Building Services Engineering, with Susie Diamond, Partner at Inkling LLP.
www.cibse.org/events

SoPHE Conservation & Control of Water in Commercial Installations
17 September, Manchester
SoPHE talk with Ross Rigby of Delabie.
www.cibse.org/sophe

Ventilative Cooling: Using the Cooling Potential of Ventilation to Reduce Energy Use in buildings
17 September, Uxbridge
A Natural Ventilation Group seminar presenting current work on ventilative cooling.
www.cibse.org/nvg

Yorkshire Region: Modernising Britain's Railway Stations – The Building Services Perspective
17 September, York
TATA Steel Projects in York will present its experience of designing services solutions.
www.cibse.org/events

Design Risk Management, Spotlight on CDM 2015
18 September, London
Gillian Birkby, legal advisor to the Association of Project Safety, will discuss the implications of the consultation on the new CDM Regulations.
www.cibse.org/events

HCNE Region: An Introduction to Rotary Diesel UPS Systems
23 September, London
With speakers Paul Williams and Sam Brockington from Hitzinger.
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ILEVE Information Day
23 September, London
www.cibse.org/ileve

Jonathan Speirs Memorial Lecture
25 September, Glasgow
Memorial Lecture for Jonathan Speirs.
www.sll.org.uk

North East Region: Part L Update
29 September, Newcastle upon Tyne
Ant Wilson of AECOM will be conducting a presentation of Part L 2013 updates.
www.cibse.org/events

Merseyside & North Wales Region: Membership Briefing
29 September, Merseyside
The briefing will focus on applications for the Associate and Member grades and registration with the Engineering Council at Incorporated and Chartered Engineer level.
www.cibse.org/briefings

HCNW Region: Energy Efficiency Questions for the Panel
30 September, Letchworth Garden City
A joint event with Transition Town Letchworth with a panel including a local architect, a building services engineer, and an energy efficiency advisor.
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Lighting & Energy Efficiency
16 September, Leeds

25 Ways to Save Energy in Your Building
19 September, London

Building Services Overview
19 September, London

Running Projects Effectively
23 September, London

Rainwater and Greywater Recycling
24 September, London

Energy Regulations: Part L
25 September, Manchester

17th Edition Wiring Regulations
26 September, London

Practical Controls for HVAC systems
30 September, London

Emergency Lighting to Comply With Fire Safety
30 September, London

Sanitary and Rainwater Design
1 October, London

Energy Management System: IS050001 (ESOS)
2 October, London

Introduction to Electrical Services in Buildings
3 October, London

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

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15 September, London

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22-23 September, London

Young Lighter of the Year

19-20 November
ExCel, London

The Society of Light and Lighting will announce the winner of the Young Lighter of the Year competition at LuxLIve 2014. Now in their 20th year, the awards provide a unique platform for young lighters. Shortlisted finalists will present their papers in front of industry expert judges at the LuxLive exhibition, before the winner is announced.

The two-day conference will combine cutting-edge lighting technology with indepth case studies.

Video blogs from the four finalists will be available to view from October at **www.sll.org** For more information and to register for free visit **www.luxlive.co.uk**

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QEII, Westminster, London.
28-29 October 2014

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- Kerry Mashford, Chief Executive, National Energy Foundation
- Sylvie Sasaki, Plan A Project Manager, Marks & Spencer
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For more information call Steve Webb on 01892 518877 or to view the full programme and book your place visit www.cibse.org/conference

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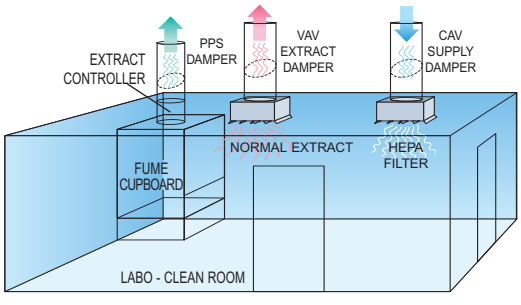

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PPS Damper

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