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The comfort zone

There is still lots of uncertainty over what long-term effect Brexit will have on construction markets. Data recorded after the vote points to a slowdown, but the decline in contracts, transactions and house prices is not as precipitous as feared.

The London residential market is thought to be vulnerable to a house price cash, with a huge number of £1m-plus flats currently being built in the capital. Though house prices have softened since the vote, they have not collapsed. Markets are generally holding firm but, with the government not expected to start negotiating an exit from the EU until 2017, the industry may need the stamina of Mo Farah and the nerves of Maddie Hinch to see out the consequences of Brexit.

One cause for optimism has been the recent activity among developers on the huge Nine Elms project. This included Dubai-based firm Damac awarding Lendlease the contract to build a 50-storey mixed use tower (page 9). It is designed by Kohn Pedersen Fox, which is also behind the ambitious conversion of King’s Reach Tower on London’s South Bank, which we feature on page 36. The challenge of converting offices into luxury apartments was immense, not only in designing plumbing for residents’ kitchens, showers and baths in 11 apartments per floor, when previously there was only provision for toilets and tea-making.

On the other side of the river is another prominent tower which has had challenges of its own. During construction of 20 Fenchurch Street sustainability credentials were somewhat put in the shade by the solar glare caused by its curved glass façade – which has since been rectified by the addition of south facing brise soleil. Hilson Moran’s Vince Ugawo draws attention to the building’s innovative green features, including a fuel cell and the extensive Sky Garden that allows the general public to share panoramic views over London with the City’s bankers and insurers.

Measuring and understanding occupants’ comfort is a recurring theme this month. We look at Cundall’s application of the Well Building Standard, and architect AHMM assesses productivity levels in its London office, which unusually for an office in a prominent urban heat island, has no air conditioning. This area of study is nothing new. David Boswell Reid was evaluating occupier satisfaction of MPs in Victorian Britain while devising an environmental strategy for the House of Commons. Read how far ahead of the game he was on page 70.

Alex Smith, editor
asmith@cibsejournal.com
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essentials right from the get-go.
Rise in STEM A levels ‘scratching the surface’ of industry’s problem

Aecom says UK has a 38% annual shortfall of workers with engineering skills

This year’s A level results showed an improvement in maths and an increase in applications for science-based degrees – but, say employers, numbers are still far short of what the building engineering industry needs.

The number of students studying science, technology, engineering and maths (STEM) subjects has risen by an average of 1,714 per year (0.61%) since 2012, but this barely ‘scratches the surface’ of the UK’s engineering shortfall, according to Aecom. The consultancy has also tracked a slight fall in numbers since last year.

‘While the overall volume of students sitting A levels in all subjects fell slightly in 2016, the numbers studying ICT [information and communications technology], physics, and design and technology subjects dropped by significantly greater margins,’ a company statement said.

Aecom added that the UK needed to recruit an average of 182,000 workers with engineering skills per year between 2012 and 2022, but had an annual shortfall of 69,000 (38%). It called for a coordinated campaign by government, industry and education providers to ‘make young people aware of the diverse and fulfilling career options opened up by STEM qualifications’.

Skills shortages hit project quality

The vast majority of public sector project managers believe skills shortages in their supply chains are having a negative impact on their projects.

Of 150 senior managers surveyed this summer by the Scape Group, 85% said the skills shortage was directly responsible for quality problems on their sites; 35% said it was ‘bad’ or ‘severe’; and 80% said it was making it difficult for them to keep to budget.

Contractors and subcontractors were also surveyed, with 58% saying skills shortages were having an impact on the quality of their workmanship and contributing to rising costs.

The report, Sustainability in the Supply Chain, also revealed that small- and medium-sized enterprises (SMEs) found the public sector tendering process difficult, with 51% saying they are not well-informed about future public sector contracts.

Scape Group chief executive Mark Robinson said the skills shortage was ‘severely impacting the quality of what we are building, but also our ability to build it on budget’. He added that there was ‘a mountain to climb’, but firms could put recommendations in place to ease the burden, citing the fact that ‘19% of contractors and subcontractors do not have apprenticeship schemes’.

Renewables outstrip coal

Latest government statistics show that, for the first time, renewable energy has outstripped coal as the main source of electricity generation in the UK.

In 2015, a quarter of the country’s electricity was from renewables, a 29% increase on 2014. Wind power was responsible for almost half Coal, meanwhile, generated 22% of the country’s electricity, down from 30% in 2014.

Mat Smith, deputy chief executive of RenewableUK, said the figures prove renewables are ‘now part of our energy mainstream’. ‘The government took the right decision when it announced the phasing out of coal. Now we can see renewable energy filling the gap, replacing old technology with new’.

VR adoption set for dramatic growth

The use of augmented/virtual reality (AR/VR) by CAD users will increase by 140% over the next five years, according to a survey by IT research firm Business Advantage Group.

As current adoption levels are relatively low, this equates to 8% of CAD users and managers using VR or AR in 2017, and 12% by 2021.

The Group’s survey also revealed that the application of building information modelling (BIM) by CAD users has fallen this year, from 21% to 19%.

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DEVELOPERS BACK NINE ELMS

Lendlease has won a £200m contract to build a 50-storey tower in the Nine Elms district of London for Dubai-based developer Damac.

Aykon London One will have two interlinking towers that will include 450 homes, affordable housing, retail and office space. The architect is Kohn Pederson Fox Associates.

It follows news that Balfour Beatty has won the contract to build a 33-storey residential tower for students nearby, and picked up pre-construction work on the £1bn One Nine Elms twin towers.

Market fall after ‘Leave’ vote was not as bad as feared

- Clients adopted a wait-and-see approach over summer

The construction market slowed at its fastest rate since 2009 in the wake of the EU Referendum result, but still not as dramatically as some economists feared, according to figures from Markit/CIPS.

Its latest UK construction report showed a growth figure of 45.9 in July, down very slightly from June’s figure of 46.0, but still below the score of 50.0 that reflects growth.

Commercial building fell at its steepest rate for nearly seven years, while civil engineering saw a fall in output for the first time this year. Housebuilding experienced a steady decline in July, but this was not as sharp as June’s three-and-a-half year low.

Construction firms are concerned about a shortage of private sector investment, but some reports showed demand patterns had been more resilient than expected, according to Tim Moore, Markit’s senior economist. He added that some positivity could be taken from the fact that the fall in output was only marginally worse than June’s seven-year low.

‘Construction firms generally suggested that clients had adopted a wait-and-see approach, rather than curtailing or cancelling forthcoming projects during July,’ Moore said.

The latest figures from industry analysts Barbour ABI revealed that the value of construction contracts fell by 6.4%, to £5.8bn, in July compared with June.

Infrastructure was hardest hit, with a fall of 20%, but the commercial office sector enjoyed a 22% increase, to £848m — although £250m of that came from one development. Housing contracts fell by 7%.

Confidence in the London new-build housing sector has been given a boost after developer Damac signed a £200m deal with Lendlease to build a 50-storey tower in Nine Elms (above). Planning applications since Brexit have also shown no sign of decline.

Planning Portal data showed around 2,000 applications a day were submitted online — the same as before the vote.

- Read CIBSE President John Field’s blog on Brexit at www.cibsepresidentblog.co.uk

CIC backs Brexit working group

The Construction Industry Council (CIC) is to support a working group – established by the Institution of Civil Engineers, under Sir John Armitt to lobby negotiators on behalf of the building engineering sector in the run-up to Britain’s exit from the European Union.

Council members also agreed to collect and disseminate data and to share information among the professions.

CIC chief executive Graham Watts said professional bodies had been ‘proactive in providing policy leads and briefings on the likely impact of Brexit’ since the referendum in June.

‘CIC can add value to that activity by supporting emerging consensus policy lines, acting as the hub for sharing information, and using the extensive network of the professional bodies to gather data and information,’ he added.

September 2016 CIBSE Journal

CHP cost savings

Combined heat and power (CHP) could save the NHS £26.4m per year by 2020, according to a new report.

Securing Healthy Returns, published by the Sustainable Development Unit for NHS England and Public Health England, also states that CHP has the potential to cut carbon dioxide (CO2) emissions by 3,750 tonnes per year. However, its authors acknowledge that, from 2021, gas CHP is expected to be a higher carbon emitter than grid electricity.

The report analysed 35 measures that it says could save £400m and reduce carbon emissions by one million tonnes every year by 2020.

Of the 18 energy-saving measures covered in the report, CHP offers the highest annual potential cost savings, followed by: staff energy awareness and behaviour change (£21.5m); high-efficiency lighting (£17.2m); and reducing temperature set points by 1°C (£6.2m).

Housebuilders sceptical about government target

The government’s target of building one million new homes by 2020 is not achievable, according to 74% of housebuilders who responded to a survey by the organisers of this year’s UK Construction Week.

More than half of those surveyed also said Brexit would make meeting the UK’s new housing needs more difficult, with only 11% saying it would make it easier. More than 60% said the government’s Starter Home scheme would not boost supply, and only 40% said government initiatives would increase the number of affordable homes.

According to 64% of housebuilders, small and medium-sized enterprises (SMEs) are vital to the market; however, more than 60% said they did not believe the private sector was capable of building enough homes to tackle the lack of UK supply, with many citing SMEs’ lack of access to finance as a major barrier.

More than two-thirds of respondents said increasing the use of off-site construction could deliver more new homes.
Up to 100% of apprentice training costs to be taxpayer-funded under DfE proposals

More than 90% of employers in England will not pay into the Apprenticeship Levy, but will receive the costs of training apprentices.

The government has sought to dampen speculation about the future of funding for apprenticeships by publishing new proposals for £2.5bn to be invested in apprentices’ training by 2020.

Only employers with an annual wage bill of more than £3m will pay into the Apprenticeship Levy, which is due to start next May. According to the Department for Education (DfE), this means 98% of employers in England will not have to pay anything into the scheme, but will still receive from the taxpayer 90% of the costs of training an apprentice.

Extra support, worth up to £2,000 per trainee, will also be available for employers and training providers that take on 16- to 18-year-old apprentices or young care leavers. Employers with fewer than 50 employees will have 100% of training costs paid for by the government if they take on these apprentices. This will help to ensure every young person, regardless of background or ability, has the chance to make their first step into work, the DfE stated.

The department has also proposed to simplify the apprenticeship system by creating 15 funding bands – ranging from £1,500 to £27,000 – to reflect the different costs of training in the various industry sectors.

Tony Howard, director of training at the Building Engineering Services Association (BESA), welcomed the proposals, but called for the funding to be brought forward to this year so that employers do not delay vital recruitment decisions.

“We applaud the potential 90% government funding and the uplifting of STEM [science, technology, engineering and maths] subject areas by 40% for Level 2 apprentices and 80% for Level 3 apprentices,’ he said.

‘However, if we are to move successfully into the Trailblazers and Future Apprentices programmes, we need that funding to be available now – not next year.’

Mothers miss out on pay rises and promotions

The gap between the wages of male and female workers widens after women have a baby, according to a report by the Institute for Fiscal Studies (IFS).

Over the subsequent 12 years, women’s hourly pay rate falls 33% behind that of men, partly because some women return to work on a part-time basis and miss out on promotions.

Robert Royce, one of the authors of the report, said women who chose to cut their hours after returning from maternity leave lost out on wage progression. On average, women earn 18% less per hour than men, according to the IFS.

This gap between the sexes’ hourly pay rates had been closing in recent decades – it was 23% in 2003 and 28% in 1993. However, when women return to work after the birth of a first child, that wage difference per hour widens.

When women who had the same hourly wage were compared, it was found that – on their return to work – their wages, on average, were 2% lower for each year spent out of paid employment. This increased to 4% for more highly educated women.

Another study, commissioned by Innovate UK, showed that 31% of female innovators feel that being a woman in a male-dominated industry has negatively affected their career.
A tenth of UK electricity used for air conditioning

Cooling buildings with air conditioning systems accounts for almost one tenth of UK electricity consumption, according to a BRE study looking at energy use by air conditioning in non-domestic buildings, backed by the Department for Business, Energy and Industrial Strategy.

The analysis of existing cooling demand and consumption data, along with technology trends, revealed that 65% of office space and 30% of retail space now have air conditioning. It estimated that cooling in offices typically uses around 40 kWh/m² per year.

Researchers found that air conditioning was often used even when buildings are unoccupied – for example, in the evenings and at weekends. The report also revealed that heatwaves are more frequent in the UK, rising from five in 1961 to 17 in 2003 in south-east England. Analysis of Energy Performance Certificates indicated that more than half of air conditioning systems in the UK are split systems. Only 10% have AC recommendations, but these mostly relate to more efficient equipment, including variable speed drives.

BRE recommended updating the government’s product model and developing an algorithm to estimate peak and monthly demand.

Workers’ concern over poor IAQ

Almost 70% of UK office workers believe poor indoor air quality (IAQ) is having a negative effect on their productivity and wellbeing, according to a YouGov survey commissioned by the Building Engineering Services Association (BESA).

A third are concerned that poor IAQ could be having a negative impact on their health. Frequent lapses in concentration were experienced by 68%, and 41% regularly had watery or irritated eyes, which they blame on the indoor environment.

The survey followed a report by the Royal College of Physicians, which said air pollution could be responsible for at least 40,000 premature deaths a year in the UK. BESA chief executive Paul McLaughlin said: ‘We need to provide good-quality, healthy indoor air through well-designed and maintained ventilation.’

CHILLING OUT ON THE TUBE

Passengers on London Underground’s Victoria Line are set for a more comfortable ride, after a new chiller system was installed between Blackhorse Road and Walthamstow Central. Fresh air is drawn from the street by the fan system and through coils that have chilled water flowing through them. The cooling fan can move the equivalent of 33 double-decker buses full of cold air every minute, and this is sent into a mid-tunnel shaft between Walthamstow Central and Blackhorse Road stations, reducing temperatures on the platforms and in the tunnel by up to 3°C.

In brief

LEGAL EAGLES LAUNCH BIM REPORT

King’s College London has released a report outlining how the potential for building information modelling (BIM) can be influenced by the choice of procurement models and contract terms and processes.

Enabling BIM through Procurement and Contracts is backed by the Association of Consultant Architects and the Society of Construction Law, and is the result of a two-year study led by Professor David Moses. It looks at: how BIM affects legal liability; how it is treated in standard-form contracts; the contractual provisions that support it; the role of the BIM information manager; and future procurement and contract options.

BSRIA’S IAQ TOPIC GUIDE LAUNCHED

BSRIA has released a new topic guide on indoor air quality (IAQ). It is aimed at those looking for introductory information about IAQ, and offers an insight into the most common contaminants, from indoor and external sources, indicating exposure limits.

The guide also summarises the current legislation and provides a guide map of which contaminants to investigate.

Commentary is given by BSRIA’s asset performance team leader, Blanca Beato-Arribas, who said: ‘There is enough evidence that poor air quality with permanent damage to health – or even death. We should be aware of the quality of the air that we breathe, at home and at work.’

BIOREACTOR WALLS PROJECT

A €3.2m LIAR (Living Architecture) project is to develop blocks that extract resources from sunlight, wastewater and air, and fit together to create ‘bioreactor walls’.

Each block will contain a microbial fuel cell, filled with programmable synthetic microorganisms. Robotically activated, each chamber will have a variety of microorganisms chosen to clean water, reclaim phosphate, generate electricity and create new detergents.
Green bodies seek to double global building efficiency

Green building councils are joining forces with cities around the world to ramp up energy efficiency within buildings, under a new partnership between the World Green Building Council (WorldGBC) and the World Resources Institute-led Building Efficiency Accelerator (BEA).

Green building councils in Colombia, the United Arab Emirates, Poland and South Africa will work with mayors and staff in Bogota, Dubai, Warsaw and Tshwane to try to double the rate of energy efficiency by 2030. They will help cities to define the best action for making efficiency improvements and getting buy-in from people and businesses that can deliver these savings.

The BEA is one of six accelerators under Sustainable Energy for All, an initiative led by the former Department of Energy & Climate Change.

The use of open performance data could deliver £400m in energy savings from heat networks and reduce CO2 emissions by 800,000 tonnes over the next 10 years, according to research supported by the former Department of Energy & Climate Change.

Tech analysts Guru Systems worked with the Open Data Institute to examine data from dozens of networks in the UK. They identified major inefficiencies that, if addressed, would reduce capital costs by 30% thanks to more accurate plant sizing based on ‘real life’ operating information.

Heat networks account for just 2% of the UK energy market, but are central to the government’s strategy to decarbonise heating. The aim is for 25% of London’s properties to be linked to localised networks by 2025. However, researchers found widespread issues with oversizing and with the way networks are specified, commissioned and operated.

Guru Systems’ managing director Casey Cole said most of the £400m in projected savings would come from ‘a reduction in the oversizing of networks, as well as increased fuel efficiency across the lifetime of these new systems’.

Lessons learned were applied to four existing schemes and, in one, residents saw the energy tariffs they paid cut by almost 50%, from 7.7p to 3.8p per kWh. As a result, Guru Systems has created a real-time data analytics platform to help operators tackle inefficiencies, and aid correct sizing.

Performance data can help cut heat network costs by £400m

Windows that darken at a flip of a switch

Massachusetts Institute of Technology (MIT) claims to have developed a new way of making windows switch from transparent to opaque that has ‘significant advantages’ over existing systems.

Once the glass is switched from clear to dark, or vice versa, the system requires little or no power to maintain its new state. It only needs electricity when it is time to switch back again, according to MIT researchers.

The MIT system uses electrochromic materials, which change their colour and transparency in response to an applied voltage. These are different from the more common photochromic materials used in spectacles, which suffer from slower response times and undergo a smaller change in their levels of opacity.

MIT professor of chemistry, Mircea Dincă, said the new windows could lead to ‘pretty significant energy savings’, by dramatically reducing the need for air conditioning in buildings in hot climates. ‘You could just flip a switch when the sun shines through the window, and turn it dark – or even make that whole side of the building go dark all at once,’ she added.

To make sure it has a near-instantaneous response time, the researchers used sponge-like materials, called metal-organic frameworks, that can quickly conduct electrons and ions. Electricity is applied to give the window a negative charge, and positive ions attack in an effort to neutralise it. This is what causes the colour-changing effect.

They also mixed two chemicals that dye the window red and green to get to a colour that is very nearly black.

Windows that darken at a flip of a switch

Join us for a CIBSE Journal webinar, sponsored by Daikin.

Wednesday 21st September at 13.00 BST
cibsejournal.com/cpd/webinars

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CIBSE Journal September 2016
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ONE THING LESS TO WORRY ABOUT.
Awards for technical papers looking at impact of rising temperatures

Prizes to be awarded at CIBSE President’s dinner in October

The Napier Shaw and the Carter Bronze Medals have both been awarded to papers exploring the impact of climate change and rising temperatures — one on maternity wards, and one looking at indoor air quality.

Alan Short, from the University of Cambridge, Giridharan Renganathan, from the University of Kent, and Kevin Lomas, from the University of Loughborough, have won the Carter Bronze Medal for their paper *A medium-rise 1970s maternity hospital in the east of England: Resilience and adaptation to climate change*.

The paper looked at what can be done to improve resilience to increasingly hot summers at the 1983 Rosie maternity facility at Addenbrooke’s Hospital. Currently no policies exist to ensure these critical facilities remain tolerable in high heat. (See ‘Heat Stress’, *CIBSE Journal*, August 2016).

Jonathon Taylor, Anna Mavrogianni, Mike Davies et al, all from the Institute of Environmental Design and Engineering at UCL, won the Napier Shaw Bronze Medal for their paper *Understanding and mitigating overheating and indoor PM2.5 risks using coupled temperature and indoor air quality models*.

Their paper explores the impact that rising temperatures can have on the indoor air quality of different dwellings and, in particular, indoor air pollution levels from outdoor sources. It found a significant increase in occupant indoor exposure to PM2.5 from outdoor sources in dwellings when natural ventilation is used to reduce indoor temperatures.

The Carter and Napier Shaw Bronze Medals have been awarded by CIBSE for more than 30 years, and are presented to the highest-rated papers of the year on application and research respectively, published in *Building Services Engineering Research and Technology (BSERT)*. The prizes will be awarded at the CIBSE President’s Dinner in October.

CIBSE members are able to access both the BSERT Journal and Lighting Research and Technology (LR&T) Journal at www.cibse.org/knowledge. CIBSE members actively researching building services-related fields are invited to submit papers to BSERT. For more details see http://bit.ly/2bIPN6z or email s.j.rees@leeds.ac.uk

Full house for networkers

An architect, services engineer, manufacturer and acoustician walk into a building...

No, not the introduction of an industry joke, but rather the scenario that awaited more than 70 guests at the long-anticipated 2016 Inter-Institution Networking Event.

CIBSE Young Engineers Network (YEN), with members of the Institute of Acoustics (IoA); the Landscape Institute (LI); the Institution of Mechanical Engineers (ImechE); the Institute of Fire Engineers; London Forum for Tomorrow (London FFT); and the Royal Institute of British Architects, met in July for the second annual Inter-Institution Networking Event in London.

The event highlighted the enthusiasm that exists from practitioners in the construction and property sectors to work together, and offered a great chance to make connections with other young engineering and architectural professionals in an informal setting.

It is rare for the various professionals from across the construction sector to come together in informal circumstances, so it was fantastic to see the Institute of Acoustics’ younger members leading the hosting duties, and the high turnout of architects was seen as an indicator of success.

Guests were greeted with a ‘networking bingo’ card upon arrival, which encouraged them to talk to as many people as possible in the hope of winning a prize at the end of the evening.

Our thanks to the IoA, RIBA, IMechE, LI, IFE and the London FFT for co-hosting the event.
Heat networks invite feedback on Code of Practice checklists

Assessors required to use checklists to give feedback on methods for implementing them

CIBSE, with the Association for Decentralised Energy (ADE), are asking for feedback on a new scheme that allows clients to hold suppliers to account over the performance of heat networks installed using the Heat Networks Code of Practice CP1.

These ‘client checklists’ have been designed to allow clients to check that their heat network has been installed to minimum standards set out in CP1, and to give them confidence that their scheme is of high quality and will provide low cost, low carbon heat.

The consultation will allow assessors to use the checklists to give feedback on all aspects of the proposed system, as well as the methods for implementing them, to ensure that they are fit for purpose, and inspire confidence in the Code and their heat network.

The checklist approach will help clients to build up an ‘evidence pack’ of information – including measures of performance at every stage in the project – that can be used to set targets and against which the success of the scheme can be assessed.

The Heat Networks Code of Practice was launched in June 2015, and includes the minimum technical requirements and standards that are assessed by the checklists.

The consultation closes on 9 September. Responses should be submitted using the response form at www.cibse.org/CP1checklists

The checklists will be trialled later this year.

Final call for symposium papers, posters and case studies

The deadline to submit your papers, posters or case studies for the CIBSE ASHRAE Technical Symposium 2017 is fast approaching.

The theme for the 2017 symposium, taking place on 5-6 April at Loughborough University, is ‘delivering resilient high-performance buildings’, inspired by the debates and discussions dominating the industry.

The aim of the 2017 Technical Symposium is to provide evidence of the adoption and protraction of resilience in the design and operation of buildings.

The event aims to encourage the participation of both young and experienced industry practitioners, researchers and building users to share experiences and develop networks.

Material based on recent or current research and application is invited, as well as the actual or potential impact on the built environment.

All papers, posters and case studies will be peer reviewed and published electronically by CIBSE.

Visit www.cibse.org/symposium for more details. Please send abstracts by email to symposium@cibse.org no later than 12 September.

Have your say

CIBSE encourages all its members to participate in the current consultations in the area of building services, and to contribute to CIBSE responses.

Consultations are an integral part of the policy-making process, helping make policies and regulations more effective by considering the interests of affected parties, fostering informed debate and exposing the costs and benefits of different regulatory options.

By responding to consultations you can express your views and make an input into the decision making process.

Another consultation currently open for response is: EU Indicators for the environmental performance of buildings. The closing date for contributions is 23 September 2016.

For more, visit www.cibse.org/news-and-policy/consultations/current-consultations

CIBSE’s public benefit

CIBSE’s regions can help the Institution meet its responsibility as a charity, according to Chris Jones, immediate past chair of CIBSE Home Counties North West.

Jones said improving and maintaining professional and technical standards are central to CIBSE’s public benefit. He said: ‘As a charity, CIBSE serves more than a fixed group of individuals.’

The public benefit must be tangible, said Jones, even though it can be difficult to measure.

He said: ‘Regional groups deliver imaginative and wide-ranging events in a spirit of public benefit and volunteering helps deliver a “charity discount.”’

CIBSE’s Regions are run entirely by unpaid volunteers.

Jones said Regions can also work with other community groups, such as Transition Towns, which have an interest in energy efficiency and the environment.

Jones said that in 2015, the HCNW Region attracted 12% bookings from the general public.

He added: ‘Blending the public and professionals from built environment disciplines also adds breadth to a Region’s perspective, helping our Institution fulfill its charitable objects.’
Feedback

A reader questions the government’s emissions targets, and CIBSE LinkedIn group debates effectiveness of STEM education

A targeted mess?
Could we, as engineers, inject some realism into the political wish for a 57% reduction in carbon emissions (CIBSE Journal, August 2016, News, p7)? In particular that the 57% should relate to per capita emissions and not to absolute quantities.

The justification for doing this is the uncontrolled growth in the UK population since 1990, for which the original ‘designers’ of the targets don’t seem to have allowed.

According to my sources, the population was around 55m in 1990, is around 63m currently, and is expected to be 85m in 2025. So a 57% reduction in actual emissions means a nearly 70% reduction in the then per capita emissions. Similarly, the 80% target by 2050 of the 2008 Climate Change Act implies a per capita reduction of around 90%, assuming a small increase in population between 2025 and 2050.

This is plainly a near impossible target, if only because of what it means for per capita emissions for housing and building emissions. But also because it ignores the vast increase in infrastructure and, above all, in manufacturing and other export and import facilities that an increase to 85m people will need just to prevent starvation – let alone to keep everybody gainfully occupied!

John Moss, Consultant, Building Performance and Systems, Arup

CIBSE LinkedIn Group discusses the impact of STEM education

Stephen Gill MCIBSE
One significant obstacle that remains unchanged is the poor perception of engineering careers among young people. Despite all the highly commendable efforts and energy from STEM [science, technology, engineering and maths] ambassadors, the [Royal Academy of Engineering] report concludes that there has been little long-term effect. If we carry on doing the same, we can expect the same result, so a rethink is required as to how we make a career in engineering attractive to young people and their influencers.

From CIBSE Journal, August 2016

This is plainly a near impossible target, if only because of what it means for per capita emissions for housing and building emissions is not my idea of a career’. Put it to the test yourselves: ask the admin people at your place of work who they call when the photocopier or air conditioner breaks down, and nine out of 10 of them will respond with a variation of ‘an engineer’. Are they? Are you happy to share that job title with them?

Simon Owen
The (best bet in my book) solution is already there, in the shape of the brilliant work by Alison Watson and the Class of Your Own team; they are backed by numerous professional institutions, well planned and coordinated, while giving students a chance to get a GCSE and a solid base of knowledge. This year, they are even running a competition backed by Jamie Oliver – can’t do much better than that for profile raising!

David Cowbrick
I am not an engineer and have no formal qualifications, yet I have been involved in project management and engineering for most of my career. I have been a service technician, a service manager, an estimator for small projects, involved in project management and on almost every project, M&E contract managers/foremen refer to their site staff as engineers – they are not, they are electricians, plumbers, pipefitters. Talking to friends of my two teenage sons about what careers they are looking at, engineering is generally not on the list and – on delving deeper – I get responses such as ‘I don’t want to be fixing washing machines’, or ‘doing wiring in some old gran’s house’.

From CIBSE Journal, August 2016

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I am not an engineer and have no formal qualifications, yet I have been involved in project management and engineering for most of my career. I have been a service technician, a service manager, an estimator for small and large commercial, high-rise, and hospitals – including medical gases, operating theatres, chilled water hot water, DX refrigeration systems and tunnel ventilation systems where the project value was in the millions of dollars. And at the end of my career, I was employed as an engineer. I have worked in all areas of the HVACR industry. Until ‘engineer’ is better classified, then there will always be confusion – which does not help or make engineering attractive to most young people.

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The Insurance Act 2015 came into force in August, and one of its major changes relates to the concept of fair presentation of risk. Hywel Davies explores the potential implications.

**Duty of fair presentation**

Under the previous law, the insured company owed a pre-contractual duty of utmost good faith to disclose all relevant facts and not to make misrepresentations to the insurer. A relevant ‘representation of fact’ had to be ‘substantially correct’ and representations of expectation or belief made in good faith.

The test for a relevant non-disclosure under the Act is said to be anything that ‘would influence the judgement of a prudent insurer in determining whether to take the risk and, if so, on what terms’. Examples are given in the legislation of what might be considered relevant to disclose, and include: special or unusual facts relating to the risk; any particular concerns that led the company to seek insurance; and the catch-all category of ‘anything which those concerned with the class of insurance and field of activity would generally understand’ to be material.

This final group encourages the adoption of protocols for specific classes of business, listing relevant matters that a company would have to disclose. This could be a challenge in construction, because the nature of large companies – especially international ones – makes it difficult to adopt effective processes.

In addition to previous claims, all large construction contracts undertaken over several years – including subsidiaries, the scale of subcontracts and subconsultancy fees, and any contractual limitations of liability agreed with designers – may also have to be disclosed. This information will help an insurer to form a view of the good standing of subconsultants and subcontractors, and hence the likelihood of claims. So it is very relevant to assessing the premium and the overall risk being covered. It applies equally to smaller businesses.

The insured may disclose all relevant circumstances that it knows or ought to know. This is similar to the previous law, but the definition of what the insured ‘ought to know’ has been modified to include the concept of a reasonable search by the insured to determine what they ought to know. The disclosure should also be reasonably clear and accessible to a reasonable insurer.

Failing this, the Act introduces a further test, which is satisfied if the firm provides ‘sufficient information to put a prudent insurer on notice that it needs to make further enquiries for the purpose of revealing those material circumstances’. Making the insurer aware of the possible need to make further enquiries is not just a defence; it discharges the insured company’s duty, as long as it is not used to obscure facts that the company knows – which would not be acting in utmost good faith.

This may also affect those who obtain a report from consultants and then seek insurance for a risk, the assessment of which is materially influenced by details in the report. Failure to disclose the report’s content could be held to be a failure to disclose material information.

**Clear and accessible**

The second change in the Act is that the insured must disclose information ‘in a manner which would be reasonably

Companies looking for insurance will have to get their paperwork in order
clear and accessible to a prudent insurer’. This should deter the practice of supplying large amounts of information in a poorly organised format, in the mistaken belief that this is ‘full disclosure’. Such practice is more likely to be successfully challenged by insurers, so the onus is on those seeking insurance to get their information in order.

Perhaps the most significant change in the Act is to the concept of what a firm ‘ought to know’. Under the old law, this was limited to what it ought to know in the ordinary course of business. The Act provides that, for the purposes of disclosure, the company ‘ought to know what should reasonably have been revealed by a reasonable search of information available to the insured’, including information which is ‘held within the insured’s organisation or by any other person (such as the insured’s agent or a person for whom cover is provided by the contract of insurance)’.

This is likely to increase the burden of disclosure. It could mean information held by a professional adviser – such as an architect – who is not employed by the company. While the old requirement to disclose what ought to be known ‘in the ordinary course of business’ may be subjective, the new provision of reasonable search is far more objective – and, arguably, fairer.

Disclosure does not cover what the insurer knows, ought to know, or is reasonably presumed to know. There are three types of knowledge – actual, constructive and presumed. They may be presumed to know about: information they hold, such as the claims history of a long-standing client; matters of common knowledge; or ‘things which an insurer… would reasonably be expected to know in the ordinary course of business’. But they may not be presumed to know information that is, for example, on a company website, as they do not ‘hold’ that information.

Readers may wish to point out to clients that information contained in some statutory reports – such as inspections of certain ventilation systems – will be material to the client’s insurance, and that they have no alternative but to disclose the report to their insurers. Indeed, it may be deemed prudent to include this advice as a standard element in such reports, to avoid any comeback.

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Ten years ago, sustainability priorities in the construction industry were, in theory, focused on energy, recycling and a few measurable environmental impacts. Rarely did planning policies and client briefs explicitly promote social sustainability and the wellbeing of building users.

Indeed, I recall many negotiation meetings where planning officers were virtually obsessed with renewable energy technologies and completely disinterested in the long-term management implications of – or comparisons with – passive design strategies, which could arguably have delivered greater benefits. Thankfully, most planning policies have moved on and the industry now has a broader perspective on sustainability.

It’s a reassuring trend that many clients and property professionals are increasingly asking about building designs that can facilitate good health and wellbeing. We are seeing this in many sectors, but particularly in the workplace sector, where blue-chip clients are aware of the new Well Building Standard, which is stimulating interest in evidence-based design (see ‘Building well’ in CIBSE Journal, April 2016).

The benefits of designing a building that enhances wellbeing is supported by research, which shows that layout, selection of materials, catering facilities and detailed attention to comfort control can have a positive impact on staff satisfaction and productivity.

The housing sector is also recognising the need to consider the wellbeing of residents – partly as a result of consumer feedback, which has demonstrated that residents aren’t as happy as they could be. Research by the HomeOwners Alliance, for example, shows that new homes often lack character and fail to fulfil residents’ needs.

Older homes, built to more traditional expectations of spacious accommodation with good daylight and ventilation, are often considered to promote better wellbeing.

Interestingly, a recent competition arranged by a major housebuilder to design a future housing format specifically highlighted the need to consider health and wellbeing, as well as flexibility and adaptability.

Earlier this year, the UK Green Building Council (UK-GBC) mobilised a task group to evaluate the key issues on health and wellbeing in the housing sector. The group had broad membership – comprising housing associations, architects,

FINDINGS OF THE UK-GBC HEALTH AND WELLBEING IN HOMES REPORT

In summary, it was found that:

● It is vital to consider mental, social and physical wellbeing together. The industry is more used to dealing with environmental design parameters, but to enhance mental and social health, designers must consider accommodation in which people can flourish, feel content, peaceful and included, and where they can interact with the community.

● Many design features that enhance occupant wellbeing, such as better provision of daylighting, also bring environmental benefits and resource efficiencies. However, we need to be aware of – and address – the tensions of modern design challenges. For example, some systems that have been installed to meet regulatory energy and ventilation requirements – such as MVHR units – are often shown to compromise air quality because they are not properly tested and commissioned, and/or residents don’t understand fully how to operate them or change filters. Many housing associations say that some residents turn off their mechanical ventilation systems because they are too noisy, even though they provide essential ventilation.

● Careful consideration of procurement and management is crucial in the delivery of healthy homes. Good intentions may not deliver the intended outcomes and wellbeing can suffer because of poor planning and maintenance.
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ASHLEY BATESON FCIBSE is head of sustainability and partner at Hoare Lea

Humidification and Evaporative Cooling

Most factors that the task group found to have an impact on residential wellbeing may seem obvious, but it’s worth appreciating that the analysis is based on evidence – it is not just anecdotal.

There is a lot of UK and international research on things that influence wellbeing, and the academic attention in this area is increasing. The UCL Institute for Environmental Design and Engineering, for example, has just established a Master’s degree in health, wellbeing and sustainable buildings.

Interestingly, much of the research indicates that neighbourhood planning – in addition to the design of the home itself – has an influence.

Consideration of health and wellbeing is also increasingly affecting consumers’ buying processes and decision-making.

According to a large survey undertaken for the UK-GBC task group, more than 30% of homeowners would be willing to pay more for designs that consider health and wellbeing. Almost as many renters would also be prepared to pay higher rent for properties with such qualities.

So offering homes that make people feel happier is good business sense, for both house builders and landlords.

Read more on the Well Building Standard on page 30.
Heat networks fed by nuclear or fossil fuel CHP are a better investment than air source heat pumps, according to consultant William Orchard.

Figure 1: Comparing the energy required to deliver temperatures useful in buildings using electrical air source heat pumps compared with ‘CHP virtual heat pumps’ using heat at 30°C rejected from thermal power plants.

Applying the Carnot equation to CHP and electric heat pumps

The Carnot equation determines the conversion efficiency and COP for a heat to power cycle or a power to heat cycle.

- \( T_h \) = absolute temperature of heat source – eg, the hot end (K)
- \( T_c \) = absolute temperature of heat sink – eg, the cold end of the cycle (K)
- \( \text{Th} - \text{Tc} \times 100\% \)

So, for example, to take an air source heat pump, upgrading heat from air at an average temperature of 9.58°C to produce heat for underfloor heating at 30°C, the Carnot efficiency is:

\[
\frac{(30 - 273) - (9.58 + 273)}{(30 + 273)} \times 100\% = 6.74\%
\]

and the Carnot COP = 1/0.0674 = 14.85

A similar Carnot calculation – for the air source heat pump to reach 60°C – results in a Carnot COP of 6.6, and this compares with a Carnot COP using the 30°C CHP heat to deliver 60°C of 11.15 – theoretically 68% more effective.
There should be a structure that includes gas and electricity networks. This could be financed by consumer investment in ‘heat network bonds’, underwritten by government, for a new regulated ‘common carrier’.

There are different methods of allocating fuel to heat and electricity that will change the case for heat networks and CHP. The 2010 AEA report1 to the UK government recommended the ‘boiler counterfactual method’, which indicates no lower emissions for heat users with CHP, but does ensure lower emissions and costs for electricity users. In our representations to the Select Committee for Energy and Climate Change, we have recommended that it should investigate the reasons behind this seemingly anomalous recommendation, as part of its request for evidence associated with Brexit and the EU emissions trading system (EU ETS).4

References:
1 BERR-Evidence-2008 www.orchardpartners.co.uk
2 Combined heat and power considered as a virtual steam cycle heat pump, September 2011 bit.ly/2bEiuym
3 EU Emissions Trading System: Benchmarking as an allocation methodology for heat bit.ly/2bRSk7F
4 EU Emissions Trading System: Benchmarking as an allocation methodology for heat from 2013, bit.ly/2bUZ7HF

Table 1 - Economic capital investment in heat networks to access 30°C heat

<table>
<thead>
<tr>
<th>Heat pump technology</th>
<th>Delivered temperature °C</th>
<th>Electricity cost £/kWt per year</th>
<th>Justified capital investment £/kWt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air source heat pump</td>
<td>30</td>
<td>47.2</td>
<td>1,305</td>
</tr>
<tr>
<td>Power station reject heat</td>
<td>30</td>
<td>0</td>
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There should be a structure that includes gas and electricity networks, financed by consumer investment in ‘heat network bonds’.

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The first global conference of the CIBSE Young Engineers Network (YEN) was held in Hong Kong last autumn. It offered delegates from the host city, the UK, Ireland, Dubai, Australia and New Zealand a chance to find out about building services in Hong Kong and China through site visits and technical seminars.

Hywel Davies, CIBSE technical director, set the tone for the week by emphasising that engineering was a global industry. ‘Engineers need to provide the world’s population with shelter to live and work, and these buildings need heating, cooling and ventilation,’ said Davies, who reminded delegates that they were also responsible for lighting, power, safe drinking water and sanitation.

The engineers discussed how YEN could support people within the industry – from trainees to those aiming for chartered status – shared their BIM experiences, and explored policies for reducing carbon emissions.

Since the trip, I have been inspired to expand my horizons at work and beyond – and a happy worker is a productive worker!

Patrick Nicholls
Mechanical building services engineer, Morgan Sindall, and CIBSE YEN NW chair at the time of the conference, and now CIBSE NW chair

What was the most inspiring thing about the visit to Hong Kong?
Seeing commercial and residential buildings of such incredible scale. I am used to seeing large industrial buildings in my day job, but the thousands of skyscrapers in Hong Kong, and the massive hotels and casinos in Macau, were a real eye opener.

What did you learn from other YEN members?
Learning about the diverse backgrounds of other YEN chairs and vice-chairs, and sharing our experiences, was interesting. Comparing and contrasting how we do things is vital, so we can improve the way we run our regions in the face of challenges, including being volunteer-run societies.
How different was Hong Kong from your home country?
This was my first time in Asia and I loved it so much that I booked a holiday there shortly afterwards. Compared with the UK, Hong Kong was a very hectic place – but, in many respects, it was quite westernised, so the culture didn’t feel particularly alien.

What would you say to others thinking of joining YEN?
It is a fantastic opportunity to meet like-minded emerging professionals and to develop your confidence within the industry. Technical events, debates and conferences encourage conversation on what being a building services engineer is all about.

How does your employer benefit from your involvement with YEN?
The experiences I had – and lessons I learned – during the global conference, and my involvement in the South West Region, have been invaluable opportunities to further my development as an engineer.

View from Hong Kong

Eve Leung, senior engineer, WSP Parsons Brinckerhoff, and CIBSE YEN Hong Kong chair

It was great to meet young engineers from different regions. It is important to come together so we can share ideas, knowledge and experience and understand cultural differences.

Hong Kong is a unique, beautiful place – we have so many different building types in such a small, area. For designers in Hong Kong the challenge is to design building services systems in high-rise buildings in such a densely-populated area.

Working from Hong Kong there is the opportunity to work in many other markets in the region, including China, the Philippines, India and Dubai.

I have great memories of the conference. On behalf of Hong Kong YEN we are delighted that the delegates enjoyed the conference, and learnt so much from their visit to Hong Kong.
varies around the world. The energy efficiency and carbon footprint reduction schemes in different countries was particularly interesting, sparking debate among delegates about the benefits of each system.

How different was Hong Kong from your home country?
In Hong Kong, building services design challenges are often around scale. High-rise buildings are everywhere and there are 1,200 skyscrapers. We learned that the cooling capacity of the ICC – the tallest building in Hong Kong with 88 lifts – is larger than that at London’s Olympic Park.

What would you say to others thinking of joining YEN?
YEN is a fantastic resource for engineers starting their career. Events offer targeted information about systems and technologies, as well as soft skills, such as networking.

How does your employer benefit from your involvement with YEN?
I have become more confident about networking, meeting etiquette and delegation. Hong Kong renewed my awareness of the lifecycle of buildings, and the energy efficiency gains available through managed operation and well-designed controls.

An employer’s view
JDP – and, ultimately, our clients.

How did you learn from other YEN members?


History of CIBSE YEN in Hong Kong
The CIBSE Young Engineers Network in Hong Kong – formerly known as the Young Members Group (YMG) – was established in September 2001. Its aim was to meet the needs and interests of local young members of CIBSE, and offer them the opportunity to liaise with other professional institutes through young members organisations.

The idea of setting up CIBSE YMG was first mooted at the Hong Kong Branch committee meeting on 14 May 2001, and a CIBSE YMG task force was set up on 17 September to bring this about. In 2011, YMG was renamed and YEN was created.

CIBSE Hong Kong Branch YEN now has around 25 committees and more than 400 members, all of whom are graduates and students.

On behalf of HK YEN, we are glad that all the delegates enjoyed the conference. It was great to meet young engineers from different regions, and to share our ideas, cultural differences, work experiences and knowledge.
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When we asked a group of students recently if they knew about careers in architecture, civil engineering and structural engineering, practically every one of them raised a hand. But when we asked how many had heard the term ‘building services engineer’, their arms remained glued to their sides.

This was a real eye-opener for us, so we decided to design science, technology, engineering and maths (STEM) events targeting building services, as part of the Atkins Young Engineers & Scientists (YES) Programme held within our offices.

At our first event, we incorporated five areas of building services, and delivered workshops to 50 Year 9 pupils. These gave them the opportunity to try out experiments linked to a concert arena, to make it more memorable than the average STEM presentation. Each of the five workshops – covering mechanical, electrical, lighting and fire – had to function in harmony with each other to make the arena work.

Mechanical
The back-of-house area of the concert arena needed to be ventilated properly, so that changing rooms and practice rooms would all be comfortable for occupants. Using a table-top model of the area with a fan attached, students released smoke pellets from the ‘plantroom’. They then had to open ductwork dampers in the various rooms to try to get air moving around the whole of the model.

Electrical
The pupils had to come up with different methods of maintaining power to the stadium, using a table-top model of part of the building. They wired up several renewable energy sources to both light rooms and power some of the fans. They also had to work with various scenarios, such as powering the concert arena at night when solar energy sources were off and when extra power was needed.

Lighting
Using different types and colours of lighting, the pupils tested – and so learned about – how important illumination is to the show taking place on stage, and the impact that this can have on the audience.
This kind of interactive learning appeals to youngsters because many of them role-play in virtual worlds in their spare time.

Fire
A mock fire occurred in our concert auditorium as the pupils were watching a concert. They had to escape from the area while wearing ‘smoked vision’ (blocked out) glasses, and without any fire escape assistance – which was difficult. They used the experience to consider how to design emergency lighting and other features, then evacuated the area again and compared it with the first time.

How do you design a concert venue? Students came up with everything they would want in a stadium that would need to be designed by building services engineers. What would the input, process and outputs of the system be?

Afterwards, they looked at a creation through Google Cardboard glasses to get a 3D-visualisation of the space. The feedback was very positive, with students enjoying the interactive sessions and virtual reality.

Engineering is going digital and, at Atkins, we are increasingly turning to 3D visualisations to help clients get a better idea of how designs will look when they are built. This kind of interactive learning appeals to youngsters because many of them role-play in virtual worlds in their spare time.

Initiatives such as this put building services engineering in a good light. They show students what we do and offer them a taste of what to expect if they follow it as a career.

The shortage of schoolchildren studying STEM subjects has been well-documented, and we know how important it is to hook them early, because they commit to subjects in advance of sitting GCSEs. But if we keep asking the right questions, listen to what they have to say, and design the right events, we’ll have a better chance of enticing them to take up careers as building service engineers.

CJ

For details on becoming a STEM Ambassador visit www.stemnet.org.uk/ambassadors/
For many years, workers have been treated like machines – not people with different subtleties as to what makes them comfortable. Consideration of building users’ health and comfort has been fundamental to the role of services engineers, and now developers are becoming more aware of the importance – not least because healthy buildings could potentially attract higher rents.

The emergence of the Well Building Standard has been one reason for the higher profile of workplace comfort. It is an accreditation system that attempts to measure how building features impact on health and wellbeing. The first European project to receive the Well Building Standard accreditation is the London office of multi-disciplinary engineer Cundall. Being engineers the company was in the perfect position to assess the standard’s scientific credentials.

Compliance requirements for the standard fit into seven key areas: air, water, nourishment, light, fitness, comfort and mind. Each category is scored out of 10, and, depending on the total achieved, silver, gold or platinum certification is awarded.

After attaining the preconditions – 36 out of 102 features for fit-out – the Cundall office at One Carter Lane, opposite St Paul’s Cathedral, aimed for silver certification through additional credits (called optimisations), including monitoring and testing of air and water quality on a quarterly basis. However, after tallying up its provisional scores, gold appears to be within reach. The team – including architect Studio Ben Allen – now awaits formal certification, which Cundall believes will help it to retain and attract staff, as well as make them more productive.

The consultancy is tracking use and

Cundall’s new office is the first project in Europe to receive Well Building Standard certification. **Liza Young** finds out what this involved, and how it affects staff wellbeing and productivity.
absenteeism with a view to identifying whether a healthier environment leads to higher staff productivity. It doesn’t yet have evidence, but others are attempting to make the link.

A web-based energy efficiency company has devised a way of calculating productivity losses as a result of uncomfortable temperatures in offices. Demand Logic’s ‘comfort tracker’ is already monitoring 100 buildings and, according to its creators, offers order of magnitude data about potential problems. The firm also hopes to plot Well Building Standard criteria as more research becomes available (see panel ‘Comfortably productive’).

**Material selection**

Natural materials are used in Cundall’s 1,400m² ground-floor office, including solid oak cupboard doors and desk edging, birch ply desks, and a recycled, woven-nylon carpet from a Swedish manufacturer. The plastic floor covering is easy to clean, so Cundall was able to select a lighter shade. As a result, natural light is drawn deeper into the floorplate by bouncing off the reflective material, allowing 30% more daylight into the space.

Alan Fogarty, sustainability partner at Cundall, says: ‘We are now looking at reconfiguring our lighting strategy.

‘We have daylight dimming on the first row of lights, but we’re going to see how many more rows we can dim. It could be as much as 30-40% of the lights on the floorplate, which could be significant in terms of energy reduction.’

Attention to detail makes all the difference. In the kitchen, a brass worktop was chosen for its antimicrobial qualities, while the depth of the sink bowl – and its distance from the tap – were carefully considered to help prevent the spread of germs.

Perhaps the most challenging requirement is ensuring that the volatile organic compound (VOC) rating of each material – including paint – is between negligible and zero. These VOC considerations don’t stop after the fit-out is complete; Well requires constant monitoring and testing of indoor air quality.

One such test showed that Cundall was almost at three-times the level of VOCs allowed, leaving the team members scratching their heads. It transpired that the building had been cleaned the night before with cleaning fluids that had a high VOC content.

Fogarty says: ‘If the whole operation of the building isn’t considered, it doesn’t matter what you specify in terms of VOCs. You’ll only know what’s happening if you are monitoring and testing the environment.

‘With other rating tools, you produce a piece of paper at the end that says certain materials are low in VOCs. With Well, it doesn’t matter how many pieces of paper you produce – if you fail your test, you fail.’

**Air quality**

Cundall’s Shanghai office has developed a monitor that measures all aspects of air quality, including VOCs, formaldehyde, carbon monoxide, NOx, ozone, CO₂, temperature and

In the kitchen, the depth of the sink bowl and its distance from the tap were carefully considered to help prevent the spread of germs.

The Well standard stipulates that 30% of the staff should be able to eat together.

**Nabers Indoor Environment tool**

The Australian Nabers Indoor Environment (IE) tool measures and benchmarks indoor environment performance of offices.

It offers three rating types – base building, whole building and tenancy – each with a different set of parameters to be assessed.

The tool has a 12-month rating period, and uses quantitative space measurements – as well as results from an occupant satisfaction survey – to assess the quality of comfort conditions.

Tested factors are: thermal services, including temperature, humidity and air speed; indoor air quality, including ventilation and levels of pollutants; lighting to maximise daylight and minimise glare and heat; acoustic comfort, including external and internal noise reduction; and office layout, including arrangements of partitions, furniture and equipment in relation to fixed elements such as windows, heating, ventilation and air conditioning.
relative humidity. It connects to the internet and sends a reading every 15 seconds.

In high-density areas, such as meeting rooms, Well specifies that a maximum of 800 parts per million of CO₂ must be achieved. Cundall's ventilation system controls CO₂ levels by distributing air on a demand basis. So if CO₂ levels get high in one room, the system draws in fresh air from another to compensate. Cundall's green lab is normally the first to lose its air because it has plants to compensate for the deficit. The south-facing meeting room – with a mossy wall – gets natural light, so the plants are even more active and, according to Cundall's research, are able to reduce ventilation requirements by around 10% (see Cundall's study at http://bit.ly/2bArmOU).

The Well Building Standard puts a big emphasis on biophilia – the belief that there is a bond between human beings and other living systems – and Cundall's research into the restorative effects of plants on human wellbeing has resulted in the installation of a second ‘active’ green wall in the office.

According to Cundall, the richest oxygenation benefits of plants are found in the roots, not the leaves. So the office’s innovative structure is built on a wall that incorporates fans in the plenum, behind the plants, to pull air from the office through the roots, before recirculating it back into the room. Fogarty says: ‘It is fundamental that air is drawn through the root system, where the microbes break down particulate matter.’

**Comfortably productive**

The best way of getting a landlord, developer or property manager to look at staff or tenant wellbeing is to present them with a figure showing how much money they are wasting.

Tom Randall, director and development manager at online data analytics company Demand Logic, says there is a way of measuring loss of productivity.

The firm’s web-based platform – which extracts and analyses data from building management systems – now has an added function called the ‘comfort tracker’. This records space temperature, identifying areas that are too hot or too cold, before calculating productivity loss.

Randall says: ‘People’s productivity can be affected by a whole lot of issues – such as getting out of bed on the wrong side in the morning – which complicates the matter, but it doesn’t detract from the fact that temperature will affect productivity.

‘We’re not saying this number is an absolute, but – used appropriately – it is an indication of the scale of the problem.’

Its method for calculating productivity losses is based on research by the Lawrence Berkeley National Laboratory, which conducted a ‘meta-study’ of nine studies into how temperature affects productivity (bit.ly/2b3HZw6). It established the upper and lower temperature thresholds – 21°C and 25°C – within which there is no assumed effect on productivity as a result of temperature.

According to these studies, there is a 2% decrease in productivity when temperatures exceed 25°C, and a 4.7% decrease when temperatures fall below 21°C.

After collecting the sensor data, the algorithm asks to what extent space temperature is outside the productive band of 21-25°C, and for how long. This is then multiplied by the productivity loss percentages, giving the average productivity impact per sensor per occupied period per day.

To work out the monetary annual productivity impact, the platform uses three assumptions, which can be adjusted according to an individual project. In the example in the panel (right), these assumptions are that:

● There are three people to one sensor
● The average London annual salary is £41,000
● The average combined tax and office overhead is 50%

Multiplying these three assumptions produces the assumed annual staff spend, and this figure is then multiplied by the productivity impact.

Randall says: ‘This gives a reasonable starting assumption that can be adjusted according to more specific data from the client.’

He adds that a single financial figure attracts the attention of landlords or commercial property owners. ‘Asset managers do not want to get bogged down with tables, looking at kilowatt-hours – they want fast, meaningful order of magnitude data. But – as we tell all our clients – this figure must be approached with caution. It is simply a useful indication of issues worth addressing. Comfort tracking provides evidence that can become part of developers’ marketing material and key performance indicators, while paving the way to more targeted condition-based maintenance.’
Demand Logic’s platform is currently employed at 60 sites, covering 100 buildings.

One of these is the Financial Times HQ, at 1 Southwark Bridge, London, which has reported that comfort complaints have halved since installation of the platform.

The data analytics company now plans to develop functions to indicate performance against WELL Building Standard comfort criteria, including air quality and humidity. But Demand Logic is yet to look at research into the effect on productivity when recommended CO₂ or relative humidity (RH) levels are exceeded. ‘But at the very least, we can plot how sensors are performing against the threshold,’ says Randall.

He says further insight can be gained from cross-referencing space temperature data with absence rates, building user survey (BUS) results, and hot and cold complaints. ‘Ultimately, productivity goes hand in hand with comfort. And with the added pressure of tenant satisfaction, retention and landlord reputation, this issue is only going to get bigger.’

The dark red and blue circles above or below the dotted lines indicate uncomfortable temperature zones.

How many spaces were uncomfortable throughout the day?

The red area shows how many spaces were too hot, and the purple shows how many were too cold.

**Future trends**

Demand Logic applied the ‘comfort tracker’ to a fully occupied, nine-storey, 9,000m², Grade A, 2004 office, in which chillers and boilers serve fan coil units, with four air handling units.

The model assumes that, for each degree above 25°C, productivity decreases by 2%, and for each degree below 21°C, it decreases by 4.7%. By analysing average half-hourly temperatures for each zone (discounting unoccupied times), and using the above model, the calculated total effect on productivity of being outside the thermally comfortable zone is 0.24%. Assuming there are 999 staff members, that the average salary is £41,000, and the average combined tax and office overhead is 50% (factor of 1.5), the approximate annual staff spend is:

$$999 \times £41,000 \times 1.5 = £61,438,500$$

So the estimated total annual loss because of temperature-related discomfort is:

$$0.0024 \times £61,438,500 = £146,000$$

Fogarty says: ‘If we are filtering the water to such a high level, what happens when we get home in the evenings and at weekends? It has made some employees question what they are drinking from the tap and whether they should be doing this test at home.’

**Lifestyle**

Staff consultation resulted in Cundall implementing a strong hierarchy of spaces of a filtration system to meet its standards. ‘But because the industrial water filters are not WRAS [Water Regulations Advisory Scheme] approved, Thames Water won’t let us connect them,’ says Fogarty. Equally, Thames Water does not recognise the French standard to which the filter has been tested.

The team is proposing to get smaller domestic-scale filters, which will be more expensive to run.

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- Bottom access.

PVHRU
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Heat Reclaim Unit

- including desks, meeting and break-out areas. The Well standard required that there be space for at least 30% of the staff to eat lunch together.

At One Carter Lane, a series of tables and benches have been installed in the foyer, next to the kitchen. This set-up keeps food and work areas separate, and encourages healthy eating.

‘You get people away from their desks so they can switch off and socialise. Part of this is positive peer pressure – people tend to go for healthier food choices when their colleagues can see them eating,’ says Fogarty.

Cundall also provides bowls of fruit for their workers, who walk past intermittently and reach for apples or bananas.

Another Well component is fitness. To comply with its requirements, Cundall funds gym memberships, encourages staff to join running or cycling clubs, and even hosts yoga sessions. ‘We do not force people to exercise – we incentivise them,’ says Fogarty. ‘We have excellent shower and changing facilities so staff that want to work out at lunch, or commute by bike, can freshen up.’

For Cundall, the cost per head to complete Well was £200. While this is a manageable sum for a fit-out, a new-build would have a much bigger price tag.

Fogarty says: ‘The certification fees are calculated per square metre, so it becomes a very big fee for a very big building – even though the activity associated with the Well certification doesn’t expand in the same ratio. I think that’s a mistake, which will deter people from going for certification. But they can get most – if not all – of the benefits of a better working environment by just applying the standard.’

He maintains that Cundall will reap the benefits of its Well certification. ‘Without doubt it will increase productivity – if you give people a better environment, they’re going to be more productive because they are going to enjoy coming to work.’

‘That’s a minimum standard – everywhere should be a decent place to work, because you have to earn your living, so you might as well enjoy your workplace.’

Having the Well standard will also help Cundall in the jobs market, Fogarty believes. ‘If we have a certificate to prove that this is healthier than the average office, it should make recruitment easier and help us keep staff for longer. As far as I’m concerned, it’s already paid for itself. There’s such a war going on for staff – firms are looking for anything to give them a differentiator. Also, people are spending a lot more time at work, so the idea that your office is keeping you healthy is a key benefit.’

Fogarty says Well is not about producing a piece of paper, but about delivering a result. Cundall’s score can go up if it implements more features, and – equally – it can go down if the company is not fulfilling its commitments. ‘It constantly encourages you to do more,’ he says. CJ
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Until recently, Kings Reach Tower was a dowdy, concrete-clad, 30-storey, underused office block, set in an unremarkable area between Blackfriars and Waterloo bridges on the south bank of London’s River Thames. Now, the concrete cladding has gone, replaced by shiny floor-to-ceiling glazing. The tower has also grown in height, by 11 storeys, and the surrounding buildings have been spruced up. Even the structure’s name has changed: it now goes under the moniker ‘South Bank Tower’.

However, the most significant change is that the former office block is now a residential building. Almost all of the office space has disappeared from this new incarnation, replaced by 194 luxury apartments. Only eight floors of offices remain, occupying the tower’s lower levels, while its ground floor will house shops. The scheme is nearing completion, with main contractor Mace finalising the fit-out of the last few top-floor apartments. It is targeting BREEAM Excellent for the residential domestic refurbishment, retail and offices.

A vibrant mixed-use tower has emerged from a dreary 1970s London office block after engineers worked out how to accommodate a multitude of building services into its concrete structure. Andy Pearson reports.

A load of waffle

Key to the successful makeover from dreary 1970s office block to vibrant 21st-century mixed-use tower has been engineer Grontmij’s ability to accommodate a multitude of building services into the refurbished concrete structure.

The tower’s transformation began with the removal of the concrete cladding and screed from all 31 floors, along with the boiler plant from the roof, to reduce the load on the foundations. This enabled the core to be extended upwards and 11 new floorplates to be cantilevered from it. Significant modifications had to be made to the existing office core, to allow the multiple access points required to create a residential floorplate.

The screed-removal works revealed the
In their previous incarnation, the office floors contained the plumbing for simple tea-making facilities and toilets; now the floorplates had to accommodate the plumbing for kitchens, showers, baths, basins and WCs for up to 11 apartments per floor. The drainage design was made even more testing by the apartments having shower trays that fitted flush with the floor. This meant the trays had to be positioned very close to the HDPE drainage stacks to accommodate the fall on the waste pipe. ‘It was almost a case of putting the drainage where it could go and then working with architects KPF to design around it,’ explains Hale. As a consequence, he says, there are close to 30 drainage stacks at the base of the tower.

Cut and carve
In addition to piping drainage from the apartments, the engineers had to get heating, cooling and domestic water services to the apartments, plus cabled services such as power, satellite TV, broadband and telephones. The boilers and chillers are located in the scheme’s basement energy centre, and heating and cooling pipework is routed up through the building’s central core, with distribution to individual floors and apartments. Because the tower is 160m high – and pressure in the vertical pipework increases by approximately 1bar for every 10m in height – the design incorporates heat exchangers in the tower’s Level 10 plantroom, to keep the static pressure in the heating and chilled water systems within set limits.

The heating and chilled water circuits are identical; each comprises two heat exchangers – one serving floors 11 to 26 and the other floors 27 to 41. This means that, although the heating and chilled water riser pipework serving the upper floors is at relatively high pressure in the riser, the higher pressure is confined to the riser pipework because the system is not serving apartments below Level 26.

To accommodate the new pipework, the core had to be adapted using what Hale describes as a ‘cut and carve’ technique. This involved a significant number of 3D models, working closely with contractor Mace MEP, and detailed on-site surveys. ‘The 3D modelling was useful in helping to get the builder’s work right to ensure that the holes

Peter Hale, operations director at the scheme’s building services engineers.

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These works were done well in advance of the apartment internal coordination, so aspects of the apartment services design were vastly accelerated. A template approach was developed, whereby the structural modifications came with pre-coordinated service entry points cut into the steelwork before it came to site. This was used to set out the penetrations through the concrete wall. From the core, the services are distributed above the ceiling of the circulation corridor before entering the apartments above their front doors. Once in an apartment, the pipes are routed straight to the utility cupboard. ‘We try to site the cupboard as close to the door as possible,’ says Hale. Ed Moseley, design director for the structural engineers, adds: ‘The apartment servicing strategies were heavily constrained by the existing structure. The team worked together to accelerate this coordination and enable it to be incorporated into the demolition strategy, well in advance of any detailed layouts. Principles established at this stage then had to be carried through the detailed design of the apartment layouts.’

The utility cupboard contains a heat interface unit (HIU). In individual apartments, this enables hot water to be generated locally, or by a calorifier in the case of the bigger units. The HIU steps down the heating mains temperature to enable it to serve the apartment’s underfloor heating system. This is hidden beneath a false floor, where it is fitted with metal heat-spreader plates to distribute warmth effectively in the absence of a floor screed.

Cooling for the apartments is via fan coil units (FCUs) located in the ceiling void. Typically, the apartments have one FCU in the bedroom and one or two FCUs in the living room, depending on the size of the apartment. The FCUs are not fitted with a heating coil; it was decided that underfloor heating – which distributes heat more evenly – was a more suitable form of heating for the apartments than warm air from the FCU, and it offered a more comfortable climate.

Compared with the apartments, servicing the tower’s office floors was relatively simple. Again, these are supplied with heating, cooling and domestic water from the core risers. Designed as a shell-and-core scheme, the office floors are currently being fitted out with a four-pipe fan coil system.

The core also houses the lifts, which were replaced during the tower’s transformation and additional ones installed. ‘With so many high-end apartments, lift traffic analysis was important, because people don’t expect to have to wait long for a lift,’ says Hale. A new bank of lifts was added to the outside of the tower to serve the offices; these have a separate reception, on the opposite side to the residential entrance.

Sectional completion

The handover strategy was a key aspect of the construction methodology and sequencing of works. It required multiple work streams to be engaged simultaneously, digging basements while the upper levels of the tower were under construction and the apartments on the existing floors were being fitted out. The design programme was being adapted continually to reflect this.

‘A key driver, early on, was to hand over sections of the building in stages,’ says Hale. The main stages were: residential floors 11-19; residential 20-29; the tower offices and some of the retail; and, finally, the remainder of the retail and apartments. ‘This could only be achieved by starting the design with sectional completion in mind from the outset, which included planning how the scheme would be commissioned,’ says Hale. The handovers were managed by fitting heat exchangers in strategic locations on the individual services.

The real challenge with the sectional handovers, says Hale, was the fire safety, and satisfying Building Control and the London Fire Brigade that it was safe for people to occupy the building while some of the areas were still undergoing a fit-out. All fire-
detection systems had to be in place and all sprinklers connected, while a safe route out of the building for residents and construction personnel had to be maintained at all times. Fire brigade access also had to be unimpeded, the fire control room had to be up and running, and the fire-fighting lifts working.

The first sectional handover was the energy centre, housed in the extensive basement. This was originally single-storey but, during the redevelopment, the basement was excavated to form a second subterranean storey for the new plantroom, while the upper level formed the residents’ car park.

The energy centre includes a 535kW combined heat and power (CHP) plant, sized for a base space-heating load and domestic hot water demand. In addition, it houses five 3750kW modular boilers, each comprising three modules. ‘The boilers had to have a good turn-down to deliver heat as soon as the first sections were handed over,’ says Hale. ‘Pre-mixed gas-fired boilers operate more efficiently at low loads, so we have programmed the building management system (BMS) to bring the boilers on and off, to ensure they run at an optimised efficiency.’

South Bank Tower is part of a larger development, which includes an adjacent, eight-storey, 3,000m², T-shaped podium office building, which is also being reconfigured and refurbished under this scheme. As well as providing heat to the tower and adjoining office podium, the CHP supplies two mid-rise apartment blocks, Rennie Court and River Court, to help increase its run-time.

‘We did a lot of detailed thermal modelling with IES software to get the development’s overall load profile correct and then, from that, to determine the CHP base load,’ says Hale. The CHP was not brought online until March 2016, close to the scheme’s completion. ‘CHPs don’t operate effectively when the output is significantly modulated, and they should not be turned on and off on a frequent basis,’ says Hale.

Most plant was prefabricated and brought to the site on skids by the services contractor. ‘The main plantroom was populated with plant in about 21 days,’ says Hale. All the risers and main horizontal pipework distribution runs in the tower were also prefabricated. This sped up commissioning because plant was pre-commissioned before delivery and the BMS was pre-programmed.

But the benefit in a busy market of off-site fabrication is not the only thing this high-spec residential conversion has highlighted. Project teams need to have a deep understanding of their site, phasing needs to be considered from day one – and drainage is king!’

CJ

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There’s no mistaking 20 Fenchurch Street for any other building. Its striking shape – a narrow base that flares outwards as it climbs 37 storeys skywards – turns the traditional skyscraper on its head, and has earned it the sobriquet ‘The Walkie-Talkie’.

The building, designed by Rafael Viñoly, has a Breeam Excellent rating, and its environmental credentials rest on two key factors: collaboration and investment in innovative technology.

In 2004, Hilson Moran was appointed by Land Securities to help secure planning consent, which was achieved in 2007, and the original building on the site, designed by William H Rogers, was demolished in 2008. Land Securities formed a joint venture with Canary Wharf Group in 2010 and a nine-month, detailed design phase began.

As a multidisciplinary firm, we were responsible for the shell and core, CAT A fit-out for eight floors and CAT B for six, covering building services, vertical transportation, sustainability, and fire consultancy. Crucially, we were there at the outset, working with client, architect, contractor and structural engineer on the design and ongoing construction.

Taking environmental responsibility is becoming more commonplace with clients, customers and local communities. Land Securities is the first property company to set a science-based, carbon-reduction target, in line with the Paris climate change accord. It made reduced carbon dioxide (CO₂) emissions the main environmental objective for 20 Fenchurch Street, and was prepared to make the necessary investment to achieve this.

A densely populated urban environment is a challenge when it comes to large-scale energy generation. A 37-storey building for up to 7,900 workers – transported around by 22 lifts (including 14 double-deck ones), two dedicated Sky Garden lifts, two 20-tonne lorry lifts, two three-tonne goods lifts and a pair of firefighting lifts – requires a considerable amount of power.

A desire to minimise the building’s carbon footprint led to the adoption of hydrogen fuel cell technology – which is where a willingness to invest is so important. It’s not a cheap solution, but Land Securities recognised that...
Hydrogen fuel cell technology is not just cleaner – it’s 90% efficient, cheaper to run, and quiet too; at 65dBA you could hold a conversation right next to it.

It would gain a competitive edge by being an early adopter and, by encouraging others, would enable prices to start coming down.

Hilson Moran worked with Logan Energy, a fuel cell specialist, to produce a design that included a 300kWe stationary fuel cell as part of the building services installations. The DFC300-EU molten carbonate fuel cell – manufactured by Fuel Cell Energy Solutions (FCES) in the US – is fed with natural gas and supplies electricity, high-temperature heat to an absorption chiller for cooling, and low-temperature heat for space heating and water heating, arranged in a combined cooling, heat and power configuration. That 300kWe output could power almost 800 households. It produces outputs similar to a conventional CHP plant, but uses an electrochemical reaction instead of combustion; airborne oxygen combines with hydrogen from the natural gas supply to produce heat and electricity. It’s extremely efficient, and exhausts hot air and water vapour, rather than sulphur dioxide, nitrous oxide and particulate matter associated with combustion technologies. Building CO₂ emissions are reduced by as much as 7%; in a year of use, it should prevent the emission of more than 18,000 tonnes of pollutants and 260 tonnes of CO₂, compared to combustion-based generation.

It’s not just cleaner – it’s 90% efficient, cheaper to run, and quiet too; at 65dBA you could hold a conversation right next to it. With costs coming down thanks to investment in Japan, Korea, Germany and the US, Hilson Moran is keen to see more clients take up the technology.

One of 20 Fenchurch Street’s most distinctive features is its Sky Garden, which is open to the public and features 360-degree panoramic views across London. Hilson Moran was responsible for the dynamic thermal modelling and computational fluid dynamics (CFD) analysis to predict the environmental conditions. The result is an enclosed, naturally ventilated space, 155m above street level.

Wind speeds – being higher at 155m than on the ground – had to be managed to avoid draughts in the garden on windy days, where the natural ventilation may be in operation. The dampers and louvres can be opened in stages to mitigate high-speed winds, while the

● High-efficiency, fully modulating boilers to meet the building heat loads, optimise system performance and minimise energy use
● Heat recovery air handling units, incorporating heat recovery run-around coils for maximum energy efficiency
● Energy regenerative lift drives to convert energy generated by lifts into electricity, rather than heat, to be used elsewhere in the building
● Escalator energy-saving controls, which allow for energy efficient ‘slow speed’ or ‘power off’ routines when there are no passengers
● Daylight-sensing lighting, which dims when sufficient ambient natural light is available, so saving energy
● Efficient flushing systems, which recover grey water from hand-wash basins to flush toilets and urinals. The WCs are dual-flush, with an effective flush volume of 3.75 litres, while the urinals use 0.5 litres per flush from a direct flush controller. So the system generates a potential mains water saving of about 7.5 million litres per year
BIM software informs and shares the design, construction and ongoing maintenance of every outer and inner working element of a building, making collaboration, specification and visualisation far simpler.

20 Fenchurch Street is one of more than 15 building models mapped in an app developed by Hilson Moran that produces an augmented reality map. 2D overlays and 3D geometry allow users to view MEP elements in detail. The app won gold in the Best Use of Digital in the Property Sector at the 2015 Digital Impact Awards. The app is available at: www.hilsonmoran.com/standout

In pre-planning, there were some definite targets, such as: basement-to-rooftop access; BREEAM Excellent rating; future-proofing the structure and provision for tenants; and a 24% improvement over Part L.

The importance of embedding a spirit of collaboration from day one cannot be overstated. Architects, engineers, contractors and cost consultants should create a single, shared vision for any project; then they are all equally invested in its success, and closer working is a natural progression.

The team behind 20 Fenchurch Street believes it is the first UK high-rise to have been fully design coordinated across all principal disciplines and in all parts of the building using BIM. All parties shared the latest 3D Revit platform to design and track the project, coordinating the model with architectural, structural engineering and building services teams. This gave the whole team a better understanding and appreciation of each discipline’s needs during design and

> grilles on the inside of the low-level openings help reduce draughts. The space is comfortable all year round without being dependent on heating or mechanical ventilation.

The Sky Garden, which is open to the public, spans three floors and includes three eateries, a bar, an event space and an open-air terrace. There are more than 1,500 grasses, ferns and bamboos, 1,200 herbaceous plants, 230 succulents and 250 trees.

Roof-mounted photovoltaic panels generate around 27,300 kWh/a year. The system was designed so that the fuel cell and the building can be connected to a city-wide heating and cooling network in the future.

Solar-control glazing restricts heat gain on the south, east and west elevations – thereby reducing cooling demand – and external fins give solar shading to the east and west façades.

LED lighting reduces energy use by around 15% and the lights last four times as long as fluorescent luminaires. For details of other specifications, see panel ‘Specifications’.

> Concept stage CFD model produced to show likely air temperatures during summer in the Sky Garden

Stand-out BIM

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> the build. It also meant that there was an instant, auditable clash-detection system, plus visualisation for every facet. This resulted in cost and time savings over the course of the project that far outweighed the initial outlay. It also reduced the project mobilisation programme by 25%.

BIM helps to coordinate the design process. For example, the unique structure of the tower means that, as height increases, more beams are getting in the way of building services. Being able to trace the inner workings of each element of design creates the earliest possible awareness, and encourages all disciplines to put their heads together to find the best solution.

Because Hilson Moran was responsible for the base build and much of the fit-out, it was able to future-proof the space for occupants. While drawing more than 100km of pipework and 300km of cable in designing the mechanical, electrical and public health (MEP) services, for example, it was concluded that tenants needed more control over their space.

So, as part of the CAT A fit-out of the 32 office floors, more than 4km of Legrand’s Electrak Buscom trunking was specified; this is an electrical busbar system that carries power and lighting controls to support a building’s lighting infrastructure and provide power to on-floor fan coils. As a plug-and-play system it creates a ‘blank canvas’ for tenants to start from scratch if they so wish – the kind of adaptability that is extremely attractive when leasing out prime real estate.

From start to finish, 20 Fenchurch Street required the project team to embrace the latest design technology, put potential before short-term cost savings in environmental tech, and have a shared vision that every member of a multidisciplinary design and construction team could buy into.

It was these three factors that enabled a BREEAM score of 80.2% to be achieved and that has resulted in the building emitting 31% less CO₂ than required by Building Regulations Part L. It is a way of working that we are now emulating on every project we take on.

VINCE UGAROW is director at Hilson Moran

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BUILDING HIGHER PERFORMANCE IN COMMERCIAL BUILDINGS
What could be simpler than heat networks – pumping hot water around in pipes can’t be too complex, can it? The principle may be straightforward, but you cannot design cost-effective district heating schemes using the standard building services approach – design for the peak with a flow return temperature of 82/71°C does not suffice.

Performance data is revealing that many of the recently built heat networks in the UK are inefficient because of high heat losses. There are a number of key reasons why:

- an overestimation of peak heat demands with cumulative margins added; a lack of consideration of system operation at low loads; little awareness of the magnitude of heat losses; and commissioning and operation not achieving the designed performance. In addition to the cost of these heat losses, the resultant overheating in some communally heated buildings is a serious problem.

The common solution to reducing heat losses is to apply more insulation. This is a bit simplistic and demonstrates a lack of analysis. We need to break the heat loss problem down into the individual factors that affect it: surface area; temperature; as well as insulation levels.

This article will look at the importance of achieving low-return temperatures, because this helps minimise both surface area and temperatures. Good insulation is, of course, essential. On many sites I have seen poorly specified and installed insulation; for example uninsulated – or poorly insulated – pipe supports, valves and commissioning sets.

The return temperature is the key indicator of heat network efficiency. A low return temperature results in a larger delta T, which means lower flow rates are required for the same kW delivered. This means smaller pumps and pipes are needed – the former lowers capital costs and power consumption, while the latter reduces surface area and, so, heat losses. A cooler return pipe also lowers heat losses. Lowering the return temperature to increase the delta T has many benefits over increasing the flow temperature. Lower temperatures can improve the efficiency of boilers, heat pumps and CHPs. Raising the flow temperature could beneficially be considered as part of a variable temperature system, where the flow temperature would only be increased at times of peak demand.
Designers and specifiers need to understand HIU performance better, to ensure the HIUs installed and commissioned deliver the lowest return temperatures.

Figure 2 shows the volume of primary DH flow taken by a typical HIU serving a new two-bedroom flat in a year. The graph shows the significance of the HIU performance during standby. Collectively the tests show the range in performance in the HIUs available to the UK market. Designers and specifiers need to understand HIU performance better, to ensure the HIUs installed and commissioned deliver the lowest return temperatures.

Bypasses may be installed on heat networks for flushing, to maintain minimum pump flows or system temperature, and for water treatment purposes. All of these can cause return temperatures to soar if their impacts are not fully thought through (see panel ‘How bypasses can increase return temperatures’).

A lower return temperature means designers can reduce pipe sizes. Going down one pipe size reduces capacity by 36%, and going down two pipe sizes reduces the capacity by 62%. A worst-case UK heat network system may be designed on a 20°C delta T basis – 80°C/60°C flow/return temperature. But on the basis of better specification and feedback...
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from HIU performance data, the pipes could be sized on a 80/40°C basis for space heat (50% reduction in flow rate) and 80/20°C (67% reduction in flow rate) for DHW. This could potentially allow a reduction of two pipe sizes.

Reducing pipes by one size cuts heat loss on average by 10% (at original temperatures), and reducing pipes by two sizes results in an average heat loss reduction of 19%.

Typically, most new heat networks operate at around 5K delta T – commonly 80/75°C because of poor design and/or commissioning. But if a 45°C return temperature can be achieved, along with the specification of pipes two sizes smaller, then heat losses are reduced by 43%, for an unchanged insulation specification.

New UK heat networks will continue performing poorly until the industry starts to understand if there is a wide gap between design and operating performance of their schemes so they can learn from their mistakes. Clients and network operators need to be sized on a peak design (HIU tests) – so the DH designs need to start reflecting this data to reduce plant and pipe sizes – both of which will reduce capital and operating costs. Designers need to evaluate the operational performance of their schemes so they can learn from their mistakes. Clients and network operators need to understand if there is a wide gap between design and operating performance of their networks before accepting ownership of new heat networks.

The CIBSE/ADE Heat Networks Code of Practice (http://bit.ly/2bNjILL) can help address these and other key issues. CJ

References:
2. HIU heating, Fairheat http://bit.ly/2bim0jq
3. Energy efficient district heating in practice – the importance of achieving low return temperatures, M. Crane, 2016, CIBSE Technical Symposium, p 10

MARTIN CRANE is a director at Carbon Alternatives

How bypasses can increase return temperatures

Figure 3 shows the connection of a new building to an existing operating heat network serving 460 flats. The new building of more than 200 flats has some flushing bypasses left open and the flow rate jumps from 10–20m³/hour to 60m³/hour and the delta T reduces from 25–30K to less than 5K. Between time periods 2,000 and 2,500 the DH to the new building is occasionally turned off. At these times the flow rate drops to below 10m³/hour (lower than before because April has lower space heating demands; also a small bypass, used to maintain the water quality in the DH mains to the new building, has also been closed – further reducing the flow rates). Now (later than the period shown) that all bypasses are closed, the return temperature is consistently below 50°C.

It is common to install flushing bypasses above each HIU. On another site, the design and build contractor has designed out these flushing bypasses by flushing at the HIU connections points before the HIU is installed. Often bypasses are put in at the tops of risers to maintain minimum pump flows. Figure 4 demonstrates the impact of these ‘small’ minimum flows that, while small at peak loads, are very significant at low DH loads.

Figure 4 shows measured flow and return temperature data at 15 minute intervals for a five-month period from August to end of December. It demonstrates the impact of bypasses with ‘small’ fixed flows, often used to ensure pump minimum flow rates are always maintained. Monitored flow rate and return temperature data, for a system that has no such bypasses, is shown as a flow duration curve (orange line) in Figure 4. The flow duration curve is six months of data sorted into descending order, and shows how much of the time the flow rate is only a fraction of the peak. The blue line is the return temperature recorded at each of the flow measurement points on the flow duration curve. To simulate the impact of a fixed flow rate bypass, operating at all times, a 4.2m³/hour at 80°C flow was added to the recorded DH return data, and the combined flow rate and return temperature calculated. At high flow rates, the simulated bypass flow has little impact but, at low flows, the bypass is more than doubling the DH return flow, so more than half the return flow is water at 80°C – hence the very significant rise in the return temperature. A rate of 4.2m³/hour is 10% of the measured peak flow, but only 5.6% of the installed pump set peak design flow.

To prevent these increases in return temperature, no bypasses should be installed. Instead, the pump set needs to have sufficiently large downflow to operate at the minimum system flow. This can be achieved by: not overestimating the peak; use of multiple smaller pumps; not having full peak redundancy; or use of small jockey pumps alongside the large peak flow pumps.3
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Air conditioning inspections touch on a range of aspects relating to the design, operation and maintenance of the equipment – but the reports they generate can fall short of clearly identifying ways in which energy consumption of the systems can be reduced.

That is the conclusion of a study into the energy use by air conditioning in non-domestic buildings. The report An overview of air conditioning inspections within the UK found that suggestions for improvement were often too numerous and generic to motivate owners and operators to implement effective energy-saving measures.

That is the conclusion of a study into the energy use by air conditioning in non-domestic buildings. The report An overview of air conditioning inspections within the UK found that suggestions for improvement were often too numerous and generic to motivate owners and operators to implement effective energy-saving measures.

The research – carried out by the BRE and commissioned by the Department of Energy & Climate Change (DECC), now part of the Department for Business, Energy and Industrial Strategy – is part of a wider study on Energy Use in Air Conditioning'. The authors said ‘key recommendations’ were often not tailored to the specific requirements of the systems inspected.

Many of the 500 Air Conditioning Inspection Reports (ACIRs) that they analysed for the report contained similar recommendations, with several references to standardised energy savings.

The same number of Air Conditioning Inspection Certificates (ACICs) were examined, and appeared to encourage building owners to investigate every possible option to save energy, but did not always pinpoint the most important ones for their system.

The study concluded that the limited usefulness of the procedure was because of the structure and format of the inspection and reports, rather than any lack of competency on the part of the inspectors.

The ACIRs demonstrated that they...
The sample

The data comprised 500 anonymised sets of documents, each consisting of an ACIC and an ACIR. The existence of an ACIR means that the system inspected is at least five years old.

The inspection reports covered the period from 2008 to 2014 (before the new EU F-gas Regulation in 2015).

The key characteristics of the sample are as follows:

- ACICs data represents buildings with, on average: installed cooling capacity 154kW; floor area 1,533m²; 68kg refrigerant use per building
- Median values are: 52kW for cooling capacity; 305m² floor area; 19kg of refrigerant
- Approximately one-fifth of buildings had an F-gas inspection report. This is now mandatory for systems with a refrigerant charge of more than 3kg – that is, for more than 90% of the buildings inspected
- Nearly 5% had sub-metering of the HVAC systems installed, while another 3.5% had partial sub-metering. Sub-metered building areas ranged from 26m² to 28,000m²
- Nearly 10% of the ACICs were for buildings with an installed capacity of 12kW or less, which do not require certification under the Energy Performance of Buildings Regulations (EPBR); approximately half were for buildings with installed capacities of between 12kW and 60kW
- Just over a third of the buildings certified had a floor area between 100m² and 300m²
- 15% of the buildings in the sample were located in London, followed by 3% in Manchester and 2% in Bristol

A significant number of installations not complying with the directives and regulations controlling the use of refrigerants, and equipment using refrigerants that have been phased out

The need for improved management of the maintenance and operation of air conditioning systems

**Sizing of systems**

According to the ACIRs, only 44% of systems were sized as expected, with the rest either more – or less – than expected.

A number of inspection reports also highlighted the fact that the systems installed (typically VRFs) had capacity control, which made oversizing less of an issue, according to the study.

**Operation and maintenance**

The inspection reports indicated that more than 80% of installations were well maintained; however, 25% of these included comments about poor insulation and dirty or blocked filters. The authors say that, while it is unlikely that these minor maintenance issues would have a significant impact on energy usage, they are symptomatic of a lack of attention to the operation and energy performance of the systems.

The report says that the survey of ACIRs implies that even basic procedures are not necessarily carried out with sufficient frequency or to the expected level – the authors say it is questionable how successful the move to a more energy efficient maintenance philosophy, as proposed by the Carbon Trust, could be.

According to the authors, it appears that – in some cases – the decision to classify the systems as well maintained was based solely on the presence of a maintenance agreement with a reputable firm.

The ACICs surveyed do not provide specific information about refrigerant leakage rates. However, the study says they do demonstrate low awareness and low compliance rates with the F-gas directive, and a significant proportion of installations still using hydrofluorocarbon (HFC) refrigerants. Only 10 systems within the surveyed sample used R22 replacements, according to the report.

Apart from the environmental implications, the study says this indicates that the 28% of ACIRs reporting systems with R22 looked at equipment that is at least 15 years old. The energy performance of older equipment is significantly lower than that of more modern units.

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td>27%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>16%</td>
</tr>
<tr>
<td>Documentation</td>
<td>10%</td>
</tr>
<tr>
<td>Staff training</td>
<td>10%</td>
</tr>
<tr>
<td>Metering and monitoring</td>
<td>8%</td>
</tr>
<tr>
<td>Refrigerants</td>
<td>7%</td>
</tr>
<tr>
<td>Equipment</td>
<td>7%</td>
</tr>
<tr>
<td>Internal heat gains</td>
<td>4%</td>
</tr>
<tr>
<td>System sizing</td>
<td>4%</td>
</tr>
<tr>
<td>External heat gains</td>
<td>3%</td>
</tr>
<tr>
<td>Renewable energy</td>
<td>2%</td>
</tr>
<tr>
<td>Others</td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 1 – Categories for classification of ACIR recommendations
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F-Gas inspections were carried out for only 20% of the buildings in the sample. These have been mandatory since the implementation of the EU F-Gas Regulation in 2015, but the sample inspection reports only cover the period from 2008 to 2014.

Conclusions
The authors conclude that while air conditioning inspections are comprehensive, the outcomes of them are unlikely to result in actual and quantifiable energy savings – so it is questionable whether they offer value for money to the building owner/user.

The vast majority of buildings covered by the DECC study had split or multi-split air conditioning systems. The study says that these are smaller, less complex installations and it is doubtful whether an inspection can produce any significant energy-saving recommendations, apart from ‘common sense’ guidelines to operate the units sensibly, and to maintain them effectively.

A more streamlined inspection procedure for smaller, simpler installations would seem practical, say the authors, and guidelines should consider the type of system, which can be more significant than the capacity.

The underlying scope of this aspect of the Energy Performance of Buildings Directive (EPBD) is not really inspection, but ensuring that air conditioning equipment is being operated in an efficient manner, according to the authors.

They say it is difficult to demonstrate that this can be achieved without some form of measurement of performance, and it is questionable whether inspection, in its current format, can do this.

The report says that ‘the possibility of implementing the existing approach differently – or adopting an alternative procedure – needs to be explored.’

References:
1. DECC Study on Energy Use by Air-Conditioning BRE, 2016 www.bre.co.uk/ac_energyuse

WHAT ARE AIR CONDITIONING INSPECTIONS?
They are intended to identify ways in which the energy consumption and running costs of existing air conditioning systems may be reduced, possibly with little or no capital expenditure. They differ from detailed energy audits by being non-invasive, and they do not include quantitative analysis of energy consumption. As part of the UK’s implementation of the Energy Performance of Buildings Directive (EPBD), air conditioning systems with an effective rated output of more than 12kW must be inspected by an energy assessor, with inspection repeated at least every five years. TM44 constitutes an approved inspection methodology for compliance with regulatory inspections.

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DATA CENTRES UPS TESTING

IF YOU DON’T TEST IT, DON’T EXPECT IT TO WORK

After a series of power outages at data centres, Gree’s Roberto Mallozzi looks at how to ensure there is a power supply when you really need it.

The modern world is sewn together with threads of electronic information, all of which lead back to surprisingly few data centres and information hubs. If one of these fails, communications, TV, defence, commercial and financial systems can go down for days, and information, reputation and profits can be lost.

Recent high-profile data centre failures for BT and Delta Airlines have brought the issue of reliability to the fore. Historically, data centre power cuts have been experienced by many blue-chip banks and telecoms providers, so no-one can claim immunity from such problems.

An all-too-common reason for failure is a loss of power. Of course, vital facilities have uninterruptible power supply (UPS) systems that should cut in instantly – to provide power until backup generators or alternative supplies can be brought online – but these only last for a limited time, or may not cut in at all, and this is where the real problems occur. We only really know that backup systems work when the main system fails, by which time it may be too late. So the only way to have near peace of mind is to test them comprehensively, rigorously and often.

Unfortunately, there is no such thing as a standard system. Data centres are usually custom-built, with numerous complex interfaces, which can result in cascading sets of events that are extremely difficult to predict. They also tend to be built in small steps; the days of fitting out a complete data centre with double-digit megawatts of infrastructure and waiting 10 years to see it fill up – or not – are long gone. Operators now defer the cost of anything not needed today, and build out in phases. If you are adding a few hundred kilowatts of IT load to a much larger facility, few people would want to pay for full integrated system testing (IST) of the whole facility. This can mean equipment going live with untested critical interfaces.

Few buildings are fitted out exactly the way the designer intended, or with the same equipment that was available for the original build. The greater the difference, and the more complex the addition, the more likely it is that there will be unforseen problems. There is also more scope for human error.

The scale of the extension work should inform the level of testing. If you can detail the scope of works clearly and completely on a sheet of A4 paper, you might not need to do a black building test. When an extension consists of five or six power distribution units, fed from four UPS strings with previously tested capacity, there is a strong argument that a full IST might not be necessary.

Bespoke testing of each facility is difficult and time-intensive. IST should be done at least once a month, though rarely is – and if it is not done, each time you turn off the power, there is a higher chance that it will not come back on.

The problem is magnified when a design company is appointed to plan a facility, a separate contractor to build it and another to fit it out. It is further complicated when there is more than one end-user of the facility. Every contributor must get their part right; from the equipment manufacturer to the installer. Wherever you are in the chain, it falls upon you to ensure that everyone upstream has done their bit. As an end user, insist on proof that testing is done regularly, rigorously, consistently and, of course, successfully. There is no one-size-fits-all answer.

Always keep meticulous records and test new equipment straight away.

Testing should be performed perfectly for their mandatory 15-minute test, but occasionally, it is worth testing standby equipment beyond what the policy or the insurance company says. There are many examples of emergency generators performing perfectly for their 15-minute test, but breaking down after half an hour. Remember, safety nets are only any use if they work.

Thank you to Andy Harrison of Arup for his help in researching this article.

Further reading:

- CIBSE commissioning codes (Codes A, B, C, W, R)
- ASHRAE commissioning guidelines (guidelines 0, 1.1 and 1.5) and ASHRAE commissioning standard 202
- Those new to mission-critical commissioning should refer to the widely referenced five-level approach to structuring the commissioning process

ROBERTO MALLOZZI is the managing director at air conditioning supplier Gree UK.
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We have recently witnessed a wider shift in industry thinking – from energy and carbon, towards health and wellbeing – and the arrival of the Well Building Standard in the UK is the pinnacle of this sea change.

At Allford Hall Monaghan Morris (AHMM), we believe an adaptive approach can help improve both.

AHMM’s building performance team, with students from University College London’s Environmental Design and Engineering MSc course, conducted a study into delivering suitable thermal conditions for productivity using passive design and management strategies in their Clerkenwell building (part of the Moreland’s complex). The building is one of a suite of ‘white collar factories’ that AHMM has designed for Derwent London.

This concept is an architectural philosophy that dismisses excessive and expensive climate control systems in favour of simple sustainability principles that put people in charge of their environment.

AHMM has been in the Morelands complex for some 20 years, and for just over three years in the purpose-built, Breeam Outstanding 1,600m² rooftop extension.

The existing building was a warehouse and textile factory, before being repurposed in the mid 1990s to house the area’s growing creative industries. The development consists of the existing brick and concrete warehouse top floor – cleared to create a large, open-plan studio – with a central light well, and an additional lightweight floor added to the roof.

The two studio floors are naturally ventilated, through perimeter desk-level windows and high-level windows at the central light well. The occupant strategy is for a
These approaches do not push design. However, ASHRAE Standard 55 offers a means of calculating an adaptive comfort threshold that can be applied to office buildings, encouraging a focus on occupants.

Following the 2014 World Green Building Council report into health, wellbeing and productivity in offices, the arrival of the Well Building Standard in the UK has built on wider interest in this subject and, at the same time, the way office buildings are used has changed. Occupant densities can be higher, and internal loads lower, while use patterns can be different – with hot desking, remote working, flexible hours and recreation areas incorporated into traditional office floor plates.

Morelands rooftop is near the centre of the London urban heat island, making standard thermal balance standards harder to achieve, while climatic adaptation is increasingly important as extremes are stretched.

We have been developing an architectural idea of lean buildings – efficient structures, minimum applied finishes, ease of functional adaptation and low waste during tenancy changes. Adaptive standards are more appropriate in this kind of building.

**Studying the space**

We carried out a longitudinal building use study (BUS) on our previous and current offices. This showed substantial improvements in occupant satisfaction with the facilities and conditions, apart from summer temperature and air quality. Temperature and indoor environmental quality (IEQ) have been recorded since moving into the space.

Temperatures are higher than design targets all year round but, according to the BUS results, only cause discomfort in summer. Occupant density drives overheating – the studio spaces are occupied at 6m² per person and there is a high use of technology.

High occupant density means CO₂ levels are frequently higher than recommended, and occupants report an inability to control their space. Energy consumption is lower than compliance calculations, despite inclusion of higher than predicted equipment loads.

Continuing this environmental analysis of the office, a study was done in the summer of 2015 exploring the potential of providing optimum thermal conditions for productivity.

According to existing research, the influence of temperature on workers’ productivity in office buildings has demonstrated that temperatures outside the comfort zone reduce occupants’ performance.

Researchers – such as Seppänen, Jensen and Wargocki – have found that higher temperatures have a more negative impact on general office work, and have established quantitative relationships between the indoor temperature and the rate of productivity loss.

Overheating, therefore, represents a risk not only to occupants’ health but also to their productivity. Buildings located within city centres are more likely to be affected because of the increased temperatures caused by the urban heat island. This risk is expected to grow with climate change, increasing the need for cooling and the associated carbon emissions.

In this context, the study explored the capacity of AHMM’s free-running office building to deliver suitable thermal conditions for productivity by using passive design and management strategies. (See panel ‘Free-running mode’).

Additionally, it explored whether established relationships between temperature and productivity – based on studies done in air conditioned buildings – can be equally applied to free-running buildings.

Finally, it looked at the cost and carbon emissions implications of achieving
productive thermal conditions by natural or mechanical means. This was done using a mixed methodology combining dynamic thermal simulation and a field study.

To assess the occurrence of overheating, the indoor temperature – resulting from the thermal simulations and field study – was benchmarked against two temperature thresholds: productive and adaptive.

The productive approach has a fixed threshold, while the adaptive method hinges on occupants either adapting to the building or adapting the building to suit them, while being allowed to control their environment (see panel ‘Temperature thresholds’ and Figure 1).

First, a model of the case study was built and simulated to understand its current performance and calibrate with recorded data (base case). The results showed high occurrence and intensity of overheating throughout the year, when compared to both thresholds, and an estimated productivity loss of between 10% and 20%, according to Seppänen’s relationship.

However, this loss in productivity contrasts with the results from the BUS survey, which showed the building is perceived as productive in terms of environmental conditions, despite the high temperatures. Consequently, a number of simple passive strategies were tested on the model. Those that achieved the best improvements in thermal performance were night cooling, reduced use of technology – using one monitor per person and remote servers instead of PCs – and smart-controlled windows.

These were then implemented on an improved case, resulting in a reduction of the overheating occurrence – and severity – when compared with the productive threshold. This reduced the productivity loss to an average of 8%, mainly in the summer months (see Figure 2).

On the other hand, the adaptive comfort threshold is surpassed only 3% of the time, which is admissible according to the adaptive comfort approach. This highlights a conflict in having a building that could potentially achieve thermal comfort by passive means, but at the same time incurs a theoretical productivity loss because of its thermal conditions.

A quantitative approach to this issue was taken by comparing the running costs of cooling the building to the productive temperature, against the economic losses caused by decreased productivity if the building was left free-running (Figures 3, 4, 5).

As shown in Figure 5, losses derived from overheating are almost 10 times those of the running cost of cooling (Figure 4). Conversely, the resultant carbon emissions would be of the order of 75kg CO₂ per m², with potential for increase in the coming years caused by climate change.

In parallel, the case study building was monitored both during a control week and an intervention week, where a natural ventilation strategy based on night and weekend cooling was tested. Afterwards, occupants answered a survey based on BUS methodology.

However, the occupants were not engaged in the ventilation strategy to avoid interfering with the results of the survey. This resulted in a different use of the window openings than planned, as occupants adjusted them to their own comfort, resulting in temperatures higher than the strategy was designed to achieve.

The results of the survey therefore indicated that occupants perceived the building as comfortable and the environmental conditions as productive. The analysis showed statistical significance in the correlation between perceived comfort and...
perceived productivity, suggesting that the higher the perceived comfort, the better the perceived productivity.

This indicates that productivity in free-running buildings is more related to thermal comfort than to fixed temperatures. Nevertheless, both are subjective metrics. But considering there is a different approach to comfort in free-running buildings than in heated and cooled ones, it might be reasonable to consider a different approach to productivity too. Moreover, the adaptive comfort limit would increase according to the changes in climate, potentially allowing for comfort conditions to be achieved passively.

Conclusion
Overall, the study shows that the use of passive strategies can help attain adaptive thermal comfort in central London office buildings. While the temperatures achieved don’t reach the established optimum for productivity of occupants, the results suggest a different approach to thermal comfort and productivity might be necessary for free-running buildings.

This is especially true when economic considerations are included in the cost analysis of the building, as using an incorrect approach to temperature-related productivity might point to a need for unnecessary heating or cooling, causing unnecessary carbon emissions.

Management strategies designed to exploit the strengths of the building have been developed and tested to ensure it is capable of being run passively, both now and in the future. This requires occupant engagement and behaviour change, which we are now encouraging through energy and IEQ data feedback integrated into the intranet.

AHMM has found that using its own office as a test bed for investigating environmental strategies informs our own architects about thermal comfort, building physics and operational management and environmental strategies that can be applied to other buildings. We have an evidence base to show clients the kind of strategies that can work and the kind of conditions expected.

We hope that through wider dissemination of this investigative work, we can encourage others to share data and contribute to the rapidly developing legislative framework surrounding this area. CJ

References:
1 Seppänen, O, Fisk, W & Lei, Q, 2006. Effect of temperature on task performance in office environment. Lawrence Berkeley National Laboratory, p.11.
5 CIBSE, 2013. TM52: 2013 The limits of thermal comfort: avoiding overheating in European buildings, Norwich S.

CRAIG ROBERTSON is sustainability specialist at AHMM, and INES IDZIKOWSKI PEREZ is an environmental designer at Foster + Partners

TEMPERATURE THRESHOLDS

Productive – a fixed threshold of 22°C, the optimum temperature for productivity according to Seppänen’s study, where findings suggest peak performance happens at a slightly colder than the neutral predicted mean vote (PMV) comfort.

Adaptive – adaptive comfort threshold applicable to free-running buildings as defined by CIBSE® based on the mean outdoor temperature.

Table 1: Outdoor temperature

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>15°C</td>
<td>16°C</td>
<td>17°C</td>
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<tr>
<td>Maximum</td>
<td>20°C</td>
<td>21°C</td>
<td>22°C</td>
</tr>
<tr>
<td>Minimum</td>
<td>10°C</td>
<td>11°C</td>
<td>12°C</td>
</tr>
</tbody>
</table>

Figure 3: Carbon emissions from air conditioning

Figure 4: Running costs of air conditioning

Figure 5: Cost of productivity lost due to overheating

CO₂ emissions and costs of cooling to the productive temperature compared with losses due to falling productivity of a free-running building (under three climate scenarios)
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THE COOLING CHALLENGE

Global warming is seeing an exponential rise in the demand for air conditioning around the world, which makes this book’s focus on energy saving in refrigeration timely and essential, says John Morley.

This comprehensive volume covers the theoretical and practical engineering aspects of refrigeration, and discusses – in detail – the principal applications of the refrigeration cycle, including industrial food preservation, distribution and storage, home refrigerators, comfort cooling and reverse-cycle heat recovery.

The book, which includes references and suggestions for further reading, is a good reference text for students of refrigeration engineering and for those wishing to take a professional qualification in the industry.

Many changes have been made to the text since its fourth edition, including a substantial rewrite of the refrigerants chapter, discussing the European Union (EU) F-Gas legislation and the consequent development of new fluorinated refrigerants with low global-warming impact. Other changes include: material on the development of carbon dioxide as a refrigerant; cooling technology for data centres and heat pumps; and developments in variable refrigerant flow (VRF) systems for improved energy efficiency for comfort heating and cooling.

Environmental factors

Refrigeration, in its various forms, is a major user of electrical energy and – together with refrigerant working fluid releases – can have a substantial impact on the environment.

Environmental aspects of refrigeration are discussed, with guidance on how to minimise the adverse effects through refrigerant selection, as well as system design and operation.

The environmental impact of uncontrolled fluorocarbon refrigerant emissions has resulted in substantial legislation to regulate the use of these substances, and the development of other substances and of new refrigeration systems. These aspects are covered, with references to relevant standards, legislation and industry guidelines.

System components

The thermodynamic principles that underpin the operation of refrigeration systems are discussed, including worked examples of system operation calculations, such as the ubiquitous Mollier diagram to quantify and clarify refrigerant circuit performance comparisons (see Figure 1).

There are also chapters detailing the individual components of practical refrigeration systems of all capacity ratings, from small domestic through to industrial process cooling. These incorporate illustrations, including cut-away images and diagrams showing the operating principles of components – and, in many cases, the performance curves and calculations for components such as compressors, evaporators, condensers and control valves.

As might be expected from a respected refrigeration compressor expert, Hundy discusses refrigerant compressor types, including some innovations. However, this does not detract from the detail given to other system components. Selection of components when specifying a system has a major impact on both the cost – installation and operating – and performance.
Book review

This is discussed in Chapter 10, which gives methodologies for carrying out a cost-benefit analysis leading to sound decisions around optimum component selection.

Safety

By their very nature, large refrigeration systems have to be assembled at the location, be it a manufacturing plant, warehouse or office building.

Because refrigeration systems are complex and potentially hazardous – particularly to the general public or employees in the operation – they are subject to a substantial set of mandatory standards that relate to safety, the environmental impact of their use and installation, and the qualification and training of refrigeration installation, operation and maintenance personnel. These standards are highlighted in the book.

Given the importance of the refrigeration compressor to the overall operating reliability of the system, there is a comprehensive discussion of the role of the lubricant in assuring reliable operation of the compressor.

Causes of lubricant degradation – and the importance of using installed filters and correctly specified driers in the refrigeration system – are highlighted, together with techniques to minimise the ingress of moisture during system assembly and maintenance in the field.

Food chain

Because refrigeration is a key component in the catering industry, the book details the various technologies used in the food chain, from chilling or freezing food and storage to display at the point of sale.

Copious examples are given of calculations for the refrigeration capacity needed for each of the various processes discussed. The design of cold stores offers particular challenges and these are detailed, with recommendations for specific design requirements to minimise the adverse physical effects of large temperature differences between the cold store and the external ambient (Figure 2).

Comfort cooling

Often referred to as air conditioning, comfort cooling is a very important application of the refrigeration cycle, both in terms of its overall use – numbers of units globally – and its energy consumption.

The phrase comfort cooling implies the control of temperature but not the relative humidity of air in occupied spaces.

Because refrigeration is a key component in the catering industry, the book details the various technologies used in the food chain, from chilling or freezing food and storage to display at the point of sale.

In many situations, the refrigeration cycle can be used for heating occupied spaces. Rejected heat, normally discarded to atmosphere becomes the useful component. Where cooling is a secondary consideration, this is termed a heat pump, with cooling taking place in the external environment, ground or air. Where both cooling, from a low temperature process for example, and heating are used, this is termed an integrated system.

Heat pumps can provide warmth in an energy efficient manner as the heat transferred by a heat pump from an external source is normally greater than the energy used to operate the heat pump.

Air conditioning is widely discussed, with examples of design calculations for sizing. An important part of air conditioning load computations is the calculation of the effect of moisture in the ambient air. Chapter 20 gives calculation examples for the psychrometry of air conditioning and the consequent refrigeration loads required to cool and remove moisture from air.

Refrigeration, air conditioning and heat pumps is a good source of information for engineering students or refrigeration engineers who are seeking to improve their technical knowledge. CJ

Copies are available from Amazon

John Morley is a member of the Institute of Refrigeration technical committee
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There is nothing new under the sun, so they say – and in 1852, physician David Boswell Reid completed a ventilation system in the House of Commons, using methods that bear a striking resemblance to modern building science.

Although his system was short-lived – operating for just two years before being replaced – it was based on a highly sophisticated concept derived from experiments in chemistry, physics, physiology and experimental psychology.

While he relied on the skills of engineers in architect Charles Barry’s office to realise his ideas at a technical level, Reid focused on the human and environmental aspects of building services. In essence, he conducted very early building user surveys.

Empirical observations were used to study the internal and external air quality, with particular attention paid to how the internal environment was perceived by Members of Parliament (MPs). This yielded insights that directly informed the concepts behind Reid’s plans for the Palace of Westminster, which he developed between 1840 and 1846.

Initially, he outlined a central air system serving the whole of the Palace, but these plans were eventually discarded and his responsibility for ventilation was confined to the Permanent House of Commons.

In yet another echo of today’s industry, however, there were serious difficulties in achieving effective collaboration on the project – largely because there was no methodological framework by which the knowledge and skills of a scientist could be integrated into the cross-disciplinary design process. Letters and drawings exchanged between Barry and Reid illuminate that the role of the building scientist, working alongside a team of architects and engineers, was not clearly defined or understood.

Before he was formally employed to work on the Palace of Westminster, Reid used temporary structures to develop and evaluate his ventilation concept. He carried out experiments in a model debating chamber in Edinburgh – constructed in 1836 – and continued these in the Temporary House of Commons (1836-51) and the Temporary House of Lords (1838-47). These provisional debating chambers, erected after a fire in 1834 had destroyed the medieval Palace, allowed Reid to monitor his systems over several years, and to collect large quantities of data on interior climatic conditions and the MPs’ experience. Maintaining thermal

David Boswell Reid was a pioneer of post occupancy evaluations, allowing MPs to feed back on their comfort levels during the development of the Palace of Westminster’s Victorian ventilation system, says CIBSE Heritage Group’s Dr Henrik Schoenefeldt.

FURTHER READING

*Illustrations of the theory and practice of ventilation* (1844)

*Ventilation in American Dwellings* (1858)

These books by David Boswell Reid include physiological studies on air purity, in which volunteers – after being exposed to different atmospheric conditions – are interviewed about how these had affected their concentration, appetite or physical wellbeing.
comfort and adequate ventilation rates were treated as interrelated issues, as the Scotsman aimed empirically to demonstrate the viability of his proposed stack-ventilation system to a parliamentary committee investigating potential solutions for the new Palace.

He carried out physiological studies on air purity, exposing volunteers to different atmospheric conditions and then interviewing them about how these had affected their concentration, appetite or physical wellbeing. A similar approach was used to evaluate technical solutions from a user’s perspective. Reid reported on rooms in which methods of diffusing air currents through different configurations of perforated walls, floors or ceilings were tested. Participants provided feedback on the thermal sensations produced by the incoming air currents and how these were affected by temperature, humidity or velocity.

Trials were also undertaken to determine how the high ventilation rates required adequately to cool a crowded debating chamber, illuminated by gas lighting, could be achieved without producing uncomfortable currents. As before, this was assessed by the self-reported experiences of volunteers.

However, when it came to assessing the performance – under real-life conditions – of Reid’s ventilation inside the Temporary Houses of Parliament, politicians, rather than volunteers, were used. By continually critiquing the internal conditions, MPs and peers became active agents in evaluating Reid’s system.

Maintaining thermal comfort drove the refinement of the system in the Temporary House of Commons. ‘To gain tighter control over the full range of climatic factors affecting it, the ventilation evolved into a highly complex structure, including an early form of air conditioning that provided cooling, humidification, heating and air filtration.

A sophisticated approach to environmental monitoring – not dissimilar to modern methods of post-occupancy evaluation – was also introduced. It combined the recording of physical measurements and the continual gathering of subjective feedback from MPs, with attendants operating the ventilation responding directly to the politicians’ experience.

As a psychological state, thermal comfort was not measurable through scientific instruments; it required qualitative methods that, as Reid noted in 1844, allowed the gathering of ‘information as to the ever-changing feelings of Members, of which no-one can possibly judge but themselves’.

Using a methodology by which perceived reality could be ‘metered’ alongside the measurement of physical stimuli, Reid’s monitoring system was an early example of psychophysical principles applied to architecture. He analysed several years of user responses and measurements in an effort to determine the climatic conditions at which the majority of MPs would feel comfortable.

In 1844, he wrote that ‘a temperature of 65°F, with an atmosphere moving in a very gentle stream, so as not to be perceptible, is the most agreeable in rooms that are not overcrowded’.

When it came to atmospheric humidity, Reid reported in 1852 that ‘when there is a difference of 5°F between the dry thermometer and wet-bulb thermometer next to it, I have the least number of complaints’.

Managing a climate based on feedback, however, was a difficult process that required the Serjeant at Arms, William Gossett, to moderate often conflicting responses of individual MPs. In 1839, he wrote: ‘People have different feelings with regard to temperature. People come in very hot and say, “How cold the House strikes”; and another man says, “I have been sitting here half an hour, and I am in fever”: and if I see the
Not unlike a modern BMS, attendants followed a ‘programme’ with a set range of climatic parameters and ventilation rates; these could be ‘overridden’ based on MPs’ self-reported experience.

Reid understood that meeting the expectations of every individual was impossible. He reported that there was ‘scarcely a meeting of the House at which there are not some Members who would like the temperature to be at 55F degrees, and others at 70F or 72F’. He also acknowledged that thermal comfort was not only affected by environmental factors, but also personal ones, such as clothing, health conditions or physical activity.

In the Temporary House of Lords, he investigated how far user satisfaction could be increased by creating microclimates in different areas of the chamber, each responding to local differences in crowding. Responses from the Lords, collected between 1838 and 1846, show that this new approach did not succeed in increasing satisfaction.

Reid argued that the main challenge was not technological, but the Lords’ insufficient cooperation in providing qualitative feedback – data on which attendants relied to manage the system effectively.

He continued developing the concept inside the Permanent House of Commons. The chamber was divided into climatic zones, but local control was increased further by enabling the climate and air supply around each bench to be adjusted individually. Each bench had supply ducts with sliding valves, which were manually adjusted by attendants from inside the ‘equalising chamber’ (fresh air plenum) below the main floor. (See Figure 1.)

The ventilation was designed to be highly responsive. As well as reacting to changes in the external environment – in particular local air pollution – it responded...
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to changes in indoor climate and air quality, and to personal feedback from building users. Empirical observations of external air pollution that Reid had undertaken in Westminster since 1836 informed the design of the air supply, which – being equipped with multiple inlets in different locations – could respond to local changes in the level of pollution.

As shown in Figures 1 and 2, the House had two pairs of inlets – one at roof level, serving the supply through the ceiling, and another at basement level, serving the supply at floor level. These could operate jointly or independently, as each was equipped with a separate fan, up-cast shaft and climate-control system, including means for cooling, heating, humidification and dehumidification.

The climate inside the Permanent House of Commons was monitored continually between February 1852 and April 1854. As well as measuring the physical environment using scientific instruments, Reid monitored MPs’ experience through the collection of qualitative feedback. Detailed data was collected in logbooks, which contained columns for measured data on temperature, humidity and air speed, and margins for written notes on operational procedures and Members’ feedback.

Not unlike a modern building management system (BMS), attendants followed a ‘programme’ with a set range of climatic parameters and ventilation rates; however, these could be ‘overridden’ based on MPs’ self-reported experience. Feedback on the conditions inside the chamber was transmitted to the attendants in two ways. Temperatures were logged by the Serjeant at Arms’ personal messenger and sent to the ventilator’s office every hour. The messenger also collected feedback from MPs, which was reviewed by the Serjeant at Arms before instructions were sent to the attendants.

Although his system in the Permanent House of Commons was decommissioned after two years, Reid’s control and monitoring procedures continued to be followed until 1941, when the chamber was destroyed by the Luftwaffe. It could be argued, therefore, that his most enduring legacy was his focus on the building occupant – an intangible heritage expressed through the maintenance of an intimate relationship between occupants and system management.

References:


**Key**

- **a)** Principal air inlet of the ceiling system with adjustable cast-iron louvres
- **b)** Fresh air channel passing through Central Tower, with diagonal wall marking boundary between Barry’s and Reid’s territory
- **c)** Area connected to the House of Lords (Barry)
- **d)** Back-up inlet for ceiling system, inside turret
- **e)** Fan
- **f)** Steam pipes
- **g)** Supply passage leading to House of Commons
- **h)** Fresh air chamber above central ceiling panels of House of Commons
- **i)** Vitiated air chamber above sloping side panels of ceiling
- **j)** Passage connecting vitiated air chamber with up-cast shaft
- **k)** Base of up-cast shaft, with coke fire
- **l)** Up-cast shaft
- **m)** Louvres valves at outlet of up-cast shaft

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**Figure 2: Roof-level air supply with two inlets, one facing the River Thames, the other Westminster Abbey** (Schoenefeldt, 2016)

**Logbook page, 8 April 1853 (Parliamentary archives)**

**Temperature recorded inside the House of Commons**
THE MOST COMPACT
CADB-HE/CADET-HE
87% at up to 5,400m³/h

THE MOST EFFICIENT
IDEO 450 ECOWATT
92% at up to 540m³/h

THE MOST COMPLETE
RHE
88% at up to 10,000m³/h

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Propane – a hydrocarbon (HC) – has been used successfully in industrial refrigeration for many years, although using it for chillers in the building services industry is a more recent application. But with pressure on designers, operators and building owners to reduce greenhouse emissions, a propane chiller option can provide a practical route to both operational efficiency (to reduce electrical consumption) and lower direct emissions (from leaking or discharged refrigerant). As an indication of the increasing acceptance of propane, it has recently been adopted by a large UK supermarket chain as the preferred refrigerant in chillers for refrigerated services in stores throughout the UK.

This article will consider the use of propane for air conditioning applications.

Propane as a refrigerant

Propane is a naturally occurring substance and is produced as a by-product of natural gas production and oil refining. Common general uses are as a fuel for engines; brazing and welding; portable stoves; and residential heating boilers. It is also used as a fuel for hot air balloons.

Propane is already widely used in domestic fridges and freezers. However, propane’s operating pressures and temperatures are well suited for use in air conditioning equipment, including chillers. Propane’s performance characteristics are similar to those of the now-outlawed R22 – which was phased out because of its high ozone depletion potential. Propane has good compatibility with materials commonly used in the construction of refrigeration and air conditioning equipment, and is commercially available and relatively inexpensive. It can be stored and transported in steel cylinders in much the same way as other common refrigerants. However, being flammable, there are some additional health and safety rules to observe.

When compared with hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), propane will have a lower system pressure drop and a higher heat transfer performance. Since its thermodynamic properties are well suited to the temperatures typically encountered in building services engineering, the refrigeration cycle coefficient of performance (COP) is comparatively good. As a result, the refrigeration charge for propane can be 40-60% less than other common refrigerants. Propane is non-toxic, and has an ozone depletion potential (ODP) of 0 and a global warming potential (GWP) of 3, as shown in Table 1. Its potential environmental impact is, therefore, far lower than many other commonly used refrigerants.

Because of its flammability, great care is required in the manufacture, installation and servicing of chillers that contain propane. Propane is denser than air, so if a leak occurs it will displace air and drop to the lowest point. This means it could collect into enclosed areas where there is a risk of explosion if the leaked gas comes into contact with a flame, spark or other ignition source.

Propane that is supplied for general use – such as in barbeques and patio heaters – is not suitable for use in refrigeration systems. This can contain high levels of contaminants, with purity ranging from as low as 65% to 95%, featuring high levels of moisture and unsaturated hydrocarbons. Only propane produced specifically for use in refrigeration...
systems – with a purity of not less than 98.5% and moisture content below 10ppm (by weight) – should be used.

System requirements to utilise propane

Most of the principal components – including condensers and evaporators; filter driers; sight-glasses; check valves; safety valves; shut off valves; solenoid valves; pressure switches; and thermistors – are no different from those fitted in an HFC or HCFC refrigerant chiller. Expansion valves specifically designed for use with the operating conditions of the propane refrigerant should be fitted to chillers.

The typical approach taken by manufacturers is that the chiller is: always considered to be operating in a normal situation; is gas-tight and sealed; will not be working in an explosive atmosphere; and will be commissioned by someone having the relevant experience, training and qualifications. Under these conditions, there is considered to be minimal risk. However, if a leak occurs, a risk exists of an explosion from, for example, a spark produced by an electrical device.

Chillers are produced to minimise both leakage of propane and the propane charge for the given application. BS EN 378 Part 1 contains strict limitations on the size of charge of hydrocarbon refrigerant that can be used in equipment, dependent on: room type; location and size; occupancy category; and whether the system is sealed, indirect and located in the open air. Propane is designated an A3 safety classification – refrigerants are designated a toxicity/flamability category in ISO8173 that is applied in BS EN378. ‘A’ indicates low toxicity (‘B’ is high toxicity), and the scale of 1 to 3 is used to designate the degree of flammability: no flame propagation (1); lower flammability (2); flammable (2); and higher flammability (3). No mandatory limit is placed on how much propane refrigerant can be used in a packaged chiller installed in the open air. However, some manufacturers have adopted 25kg as the upper limit for the amount of propane per circuit.

A leak detection and control system must be fitted that, when activated, will pump down the propane charge into a liquid receiver and then shut off the electrical supply to the chiller. Where a compressor is enclosed, a ventilation fan (that meets appropriate requirements of the EU ATEX – Atmosphères Explosibles directive) must be installed to remove any gas that might leak from the compressor into the enclosure – this being activated by the leak detection system.

Compressors for propane chiller applications are usually based on a reciprocating or screw design. Electrical components fitted directly onto the compressor – such as the terminal connection box, start capacitor or crank case heater – should be manufactured to at least IP54 standard (so being protected from limited dust ingress and from water splashes) or a higher rating, and meet the requirements for an A2 zone. Motor winding thermistors should be housed and wired separately from other electrical components. The compressor will be clearly labelled ‘Attention Fire Hazard’.

The electrical components must be inherently safe, and the risk of static electricity build-up limited by the manufacturer through the fitting of adequate earth bonds. Abnormal operation of the chiller, exposure to heat (fire), and various other faults may cause high-pressure refrigerant conditions. On sensing abnormally high pressure, gas should be relieved into the low pressure side of the refrigeration system, rather than released to atmosphere. If the pressure continues to rise, then the gas is released through a pressure relief valve – each chiller refrigeration circuit must be fitted with a correctly selected relief valve to release excess pressure. The valve should be mounted as close as possible, and above high-pressure liquid receivers. In the case of air-cooled condensers, valves should be fitted at the highest point of each condenser bank circuit, and should be easily accessible and clearly visible from a safe distance – so readily alerting operators of the potential

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Propane (R290)</th>
<th>HCFC (R22)</th>
<th>HFC (R134a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New equipment</td>
<td>Yes</td>
<td>Banned</td>
<td>Yes</td>
</tr>
<tr>
<td>Retrofit possibility</td>
<td>No</td>
<td>Banned</td>
<td>Yes</td>
</tr>
<tr>
<td>Ozone depletion potential (ODP)</td>
<td>0</td>
<td>0.055</td>
<td>0</td>
</tr>
<tr>
<td>Global warming potential (GWP)</td>
<td>3</td>
<td>1,810</td>
<td>1,370</td>
</tr>
<tr>
<td>Boiling point @ 1 bar</td>
<td>-42°C</td>
<td>-41°C</td>
<td>-26.6°C</td>
</tr>
<tr>
<td>Critical temperature</td>
<td>97°C</td>
<td>96°C</td>
<td>100.3°C</td>
</tr>
<tr>
<td>Critical pressure</td>
<td>43 bar</td>
<td>50 bar</td>
<td>40.6 bar</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>0.0411kg/mol</td>
<td>0.08647kg/mol</td>
<td>0.1023kg/mol</td>
</tr>
<tr>
<td>ASHRAE safety group</td>
<td>A3</td>
<td>A1</td>
<td>A1</td>
</tr>
<tr>
<td>Flammability lower limit</td>
<td>2.1% by volume</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Flammability upper limit</td>
<td>9.5% by volume</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Compatible oils</td>
<td>Mineral oil, alkybenzene, polyolester</td>
<td>Mineral oil, alkybenzene,</td>
<td>Polyolester</td>
</tr>
<tr>
<td>Appearance</td>
<td>Colourless</td>
<td>Colourless</td>
<td>Colourless</td>
</tr>
<tr>
<td>Odour</td>
<td>Sweet</td>
<td>Slight ethery</td>
<td>Slight ethery</td>
</tr>
</tbody>
</table>

Table 1: Principal properties of propane, compared with a pair of alternative refrigerants historically used in chillers

Figure 1: A 500kW air-cooled propane chiller (Source: Cool-Therm)
Efficient and reliably. Only experienced refrigerant charge and any other relevant chiller installation, including the size of the equipment has been aligned recently to the regulations and standards.

The European ATEX legislation on pressure equipment has been aligned recently to the New Legislative Framework to simplify and improve its implementation, and the new directive 2014/68/EU came into force on 20 July 2016. Propane chillers supplied in Europe must be certified and tested to comply with this newly aligned and recast directive.

The labelling on the plant must include refrigerant type and group classification, along with an indication of flammability risk. To be sold in Europe, the equipment requires an EU declaration of conformity that confirms it is in accordance with relevant regulations and standards.

**Operational responsibilities**

It is recommended that the local fire authority be advised of the location of a propane chiller installation, including the size of the refrigerant charge and any other relevant health and safety information.

As with all chillers, planned maintenance is essential to keep plant working safely, efficiently and reliably. Only experienced refrigeration technicians, who have undertaken appropriately certified training, are permitted to service and maintain propane-based chillers. As its popularity grows in the refrigeration and air conditioning industry, increasing numbers of technicians are being trained to work with propane equipment. With a propane refrigerant chiller, regular leak checks are particularly important. As a general rule, four quarterly inspections each year are considered sufficient, and record-keeping in line with the F-Gas regulations must be undertaken.

**The potential future for propane chillers**

Under the revised F-Gas regulation – which came into force in January 2015 – from 2022, a ban will come into effect on new centralised refrigeration systems for commercial use with a capacity of 40kW or more, using refrigerant with a GWP of more than 150. This will rule out many of the refrigerants commonly used in chillers today, notably R134a. Meanwhile, the race continues to develop new low-GWP refrigerants, as well as evolve systems to utilise the more environmentally benign exant refrigerants that are both safe and affordable, and can operate economically at the conditions required for building services systems.

Packaged propane air-cooled refrigerant chillers (such as that shown in Figure 1) can be a serious contender in the once commonly used refrigerant R134a. Refrigerants compatible with propane are proving to be very reliable, possibly because greater numbers of service technicians become experienced and qualified in handling propane chillers. © Ken Strong and Tim Dwyer, 2016.

**Further reading:**

- Guidelines for the use of hydrocarbon refrigerants in static refrigeration and air conditioning systems, ACRIB, www.acrib.org.uk/
- Safety code of practice for refrigerating systems utilising A2 & A3 refrigerants, Institute of Refrigeration
- Flammable refrigerants safety guide, The Australian Institute of Refrigeration and Air Conditioning Equipment

**References:**

6. Data supplied by Cool-Therm.

Table 2: Example packaged air-cooled chiller selections, based on chilled water temperatures of 6°C flow, 12°C return, and external temperature of 35°C. Data supplied by Geoclima srl/Cool-Therm

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Propane</th>
<th>R134a</th>
<th>HFO-1234ze</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor type</td>
<td>Screw</td>
<td>Screw</td>
<td>‘Turbo’</td>
</tr>
<tr>
<td>Cooling capacity (kW)</td>
<td>417</td>
<td>417</td>
<td>417</td>
</tr>
<tr>
<td>Power including fans (kW)</td>
<td>152</td>
<td>147</td>
<td>121</td>
</tr>
<tr>
<td>Energy efficiency ratio</td>
<td>C</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Energy efficiency ratio (EER)</td>
<td>2.74</td>
<td>2.84</td>
<td>3.43</td>
</tr>
<tr>
<td>Seasonal EER (SEER)</td>
<td>4.6</td>
<td>4.57</td>
<td>5.09</td>
</tr>
<tr>
<td>Approximate modulation</td>
<td>20-100%</td>
<td>20-100%</td>
<td>0-100%</td>
</tr>
<tr>
<td>Refrigerant charge (kg)</td>
<td>44</td>
<td>82</td>
<td>79</td>
</tr>
<tr>
<td>Refrigerant GWP</td>
<td>3</td>
<td>1,370</td>
<td>4,551</td>
</tr>
<tr>
<td>Length (m)</td>
<td>4.54</td>
<td>4.51</td>
<td>4.51</td>
</tr>
<tr>
<td>Width (m)</td>
<td>2.25</td>
<td>2.25</td>
<td>2.25</td>
</tr>
<tr>
<td>Height (m)</td>
<td>2.54</td>
<td>2.54</td>
<td>2.53</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>4,498</td>
<td>4,583</td>
<td>3,026</td>
</tr>
<tr>
<td>Indicative relative capital cost</td>
<td>100%</td>
<td>72%</td>
<td>98%</td>
</tr>
</tbody>
</table>

The installation and commissioning process is much the same as for any other chiller installation, although it is particularly important that a proper risk assessment is undertaken on the intended position of the chillers. Reportedly, propane chillers have proven to be very reliable, possibly because the operating characteristics are very similar to the once commonly used refrigerant R22. Service and maintenance are likely to be slightly more expensive, compared with a standard screw compressor chiller but, in time, this differential is likely to reduce, as greater numbers of service technicians become experienced and qualified in handling propane chillers.

Guidelines for the use of hydrocarbon refrigerants in static refrigeration and air conditioning systems, ACRIB, www.acrib.org.uk/


Safety code of practice for refrigerating systems utilising A2 & A3 refrigerants, Institute of Refrigeration

Flammable refrigerants safety guide, The Australian Institute of Refrigeration and Air Conditioning Equipment

References:

6. Data supplied by Cool-Therm.
Module 99
September 2016

1. What is the standard refrigerant designation for propane refrigerant?
   □ A  HFO-1234ze
   □ B  R134a
   □ C  R22
   □ D  R290
   □ E  R431a

2. What is the critical temperature for propane?
   □ A  -42°C
   □ B  -41°C
   □ C  -26.6°C
   □ D  96°C
   □ E  97°C

3. If a refrigerant has an ISO817 toxicity/flammability categorisation that indicated low toxicity and higher flammability, what would that category be?
   □ A  A1
   □ B  A2
   □ C  A3
   □ D  B2
   □ E  B3

4. Which of these would NOT be a preferred attribute of the pressure relief valve in a propane system?
   □ A  For an air-cooled condenser system, located at the highest point of each condenser bank
   □ B  Located as close as possible to, and above, high-pressure liquid receivers
   □ C  Positioned in an easily-accessible location
   □ D  Having a clearly visible discharge port
   □ E  Discharge port directed towards a low-level drain to allow refrigerant to flow away

5. In Europe, from 2022, what is the maximum GWP for commercial refrigerant in a system of greater than 40kW?
   □ A  0
   □ B  50
   □ C  100
   □ D  150
   □ E  200

Name (please print) ..................................................................................
Job title .....................................................................................................
Organisation ............................................................................................
Address .......................................................................................................
Postcode ....................................................................................................
Email ........................................................................................................
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      If so, please state your membership number
      (if available) ................................................................................................
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      (please state) ....................................................................................... 

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   □ Commissioning engineer
   □ Energy manager
   □ Facilities manager
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September 2016 CIBSE Journal
Comfort cooling at Tricorn House achieved with underfloor air conditioning

Underfloor air conditioning has proved to be a flexible approach for the phased 12-year refurbishment of Tricorn House, in Birmingham. AET Flexible Space has provided a thermally comforting solution for the multi-tenanted building, and all 10 floors of office space are now air conditioned using underfloor equipment. Switching to plenum air conditioning significantly increased headroom in the height-restricted building. The most recent specification included the latest slimline fan terminal units incorporating EC fan technology.

Call 01342 310 400 or email lucy@flexiblespace.com

Ultra-high boiler efficiency at University College London

Innovative boiler plant has been installed in University College London’s (UCL’s) Torrington Place building. The boiler house, supplied by Atlantic Boilers UK, operates throughout the year at 95°C flow and 75°C return, and contributes to the UCL ring main that serves scores of buildings, large and small. Normally, these ring-main temperatures do not allow condensing, but the Atlantic RT add-on condensing exchanger leads to year-round efficiencies of 92-97% GCV (102-107% NCV).

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

Elegantly designed high-performance slot diffusers

Advanced Air has extended its range of high-capacity slot diffusers with an architecturally pleasing design known as flowline. The aesthetics are achieved with a drywall or plastered ceiling creating a shadow gap acclaimed by architects and interior designers.

The flowline diffuser can be mounted above and adjacent to the ceiling so no parts are visible. Whether your project requires straight lines, mitred angles or smooth curves, Advanced Air can custom fabricate the flowline diffuser to meet the most demanding architectural and engineering performance requirements. Flat-face radiuses for ceilings and concave or convex curving for side-wall applications are available.

The flowline comes in different slot widths – 25mm, 51mm, 64mm and 76mm – for single- and two-slot configurations, and the range forms a complete system package with Advanced Air’s fan coil units.

Call 07767 776 843 or email tchambers@advancedair.co.uk

George Fischer named BSS Supplier of the Year

BSS Industrial, UK distributor of pipeline and heating solutions, has crowned Coventry-based George Fischer Sales as its supplier of the year for 2016. Through this award, BSS recognises George Fischer’s contribution to its own success over the past year. The supplier of plastic piping systems and metal fittings supports BSS not only in winning contracts, but also through sharing project information and making joint calls to customers.

Call 0116 245 5500 or visit www.bssindustrial.co.uk

New website from district heating experts

Evinox Energy has launched its new website, which has been redesigned and updated to make it easier for housing developers, M&E consultants and social housing providers to find information specific to their needs. The site includes comprehensive details about communal and district heating systems, including products, services and the market. Whether you’re looking for the heat network (metering and billing) regulations, or technical information to use in your design and product selection, the Evinox site can help. You can also find out about smart metering and communication networks, and how to install resident friendly, future-proofed systems.

Evinox Energy specialises in communal and district heating solutions. It has its own range of eco-efficient heat interface units and comprehensive support services, including metering, billing and revenue management.

Call 01372 722277 or visit www.evinoxenergy.co.uk

XL has all the right attributes

The XL Series is part of ATAG Commercial’s efficient range of gas-fired boilers, which offers impressive performance, high-quality and reliable engineering, and flexible cascade arrangements. Available in outputs of 60kW, 95kW and 120kW, all models achieve best-in-class NOx emissions – less than 30mg/kWh – for maximum Breeam points. Each XL Series commercial boiler incorporates an efficient and durable stainless steel heat exchanger, and they are ideal for plantrooms with limited space.

Visit www.atagcommercial.co.uk

Draka’s new Tool Fast Keystone Jack slashes cable termination time by up to 40%

Cables and systems specialist Draka – part of the Prysmian Group – has launched the Tool Fast Keystone Jack and Tool Fast Installer Tool, which allow Cat5e and Cat6 cables to be terminated up to 40% quicker than a standard keystone connector.

Compatible with fully shielded foiled twisted pair cables (S/FTP), with diameters from 23 AWG to 26 AWG, the system is third-party approved.

Draka has also launched an angled, unshielded empty patch panel for Cat5e and Cat6 data cables.

Call 08705 133 143 or email uc-connect@prysmiangroup.com
ICS Cool Energy new portable evaporative cooler to combat temperature spikes
Temperature control specialist ICS Cool Energy has launched a high-efficiency portable evaporative cooler to deliver effective cooling to commercial workspaces during seasonal temperature spikes.

Available from the company’s hire division, the Com Cool evaporative cooling unit can deliver temporary, long-term and emergency temperature control to all types of buildings and for manufacturing processes. Its tall, slim design provides optimum distribution of cooled air over an area of up to 100m², with no need for refrigerant gases. It is also easy to move around and has a water tank with 30% more capacity than others on the market. Offering high-volume air movement of 5,165m³/hr, the compact evaporative cooler is a freestanding unit that can direct cooler air in localised areas with the help of separate fans.

Call 0800 774 7426, email info@icscoolenergy.com, visit www.icscoolenergy.com or follow @icscoolenergy on Twitter

Dunham-Bush expands its national sales force
Global heating and chiller manufacturer Dunham-Bush has appointed Tony Constable as regional sales manager (heating) south. He was previously with Autron Products, as UK sales and marketing manager. Constable will bring his considerable experience to bear on promoting awareness of the Dunham-Bush System LST radiator. He will also help to integrate the LST radiator into the wider portfolio of Dunham-Bush heating products, which includes fan convectors, perimeter heating, trench heating and radiant panels.

Email info@dunham-bush.co.uk

Grundfos has a sporting chance in Brazil
Behind the scenes of the major venues at this summer’s Rio Olympics – including the Athletes’ Village – a small army of Grundfos pumps are quietly working away.

With nearly 20 years’ experience in the HVAC market, Boshell has extensive technical knowledge, while his consulting background means he can coordinate and understand every stage of a project. Boshell joins the company from Jaga Heating Products.

Email info@dunham-bush.co.uk

Fusing efficient ventilation
Effective, compliant ventilation of multi-occupancy rooms is simplified with an innovative concept from Gilberts of Blackpool.

The air movement specialist’s Mistrale Fusion (MFS) terminal delivers optimum internal air control for less than £5/room/year. The initial single-sided through-structure unit provides a one box, stand-alone solution, requiring no additional ductwork or plant.

According to Gilberts, the MFS is the first in a new series that revolutionises energy-efficient ventilation in non-domestic buildings.

Call 01253 766 911 or email info@gilbertsblackpool.com

Hard water? HygroMatik has a simple solution for liner RH control
To ensure high standards of precision air conditioning, HygroMatik’s resistive steam humidifier, HeaterLine, and water-softening system, WaterLine, can work in synergy to ensure the purest water is fed into the steam humidifier to produce the highest-quality steam.

As 60% of water in the UK is hard, installing WaterLine alongside HeaterLine units enables building managers easily to negate the risk of limescale build-up in the cylinders, which can cause a loss in efficiency and increase costs.

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

Gripple responds to amended wiring regulations
Gripple, manufacturer of wire suspensions for building services installation, has taken cable management to another level in response to new wiring regulations where fire-resistant, suspended services are required.

The all-steel Trapeze Plus FR No 3 has been launched to comply with amendment three of the 17th edition wire regulations relating to wiring systems in escape routes. It is fire-rated, with various levels of certified exposure times and load limit specifications available.

Call 07795 114667 or email f.belafonte@gripple.com

Millions of types – always unique
Guntner is setting a new standard with its modular-type Vario product range.

With virtually limitless combinations available, you can be sure of a reliable selection that is tailored to your requirements, whatever the application.

With the added benefit of the Guntner Product Configurator, you can make your own selections – saving you time and giving you the required product data.

Call 0844 22 50 600, email justin.scofield@guntner.com or visit www.guntner.co.uk

Dunham-Bush’s new sales manager
Manufacturer of heat emitters and chillers Dunham-Bush has appointed Jason Boshell as regional sales manager (heating) for northern England, Scotland and Northern Ireland.

With nearly 20 years’ experience in the HVAC market, Boshell has extensive technical knowledge, while his consulting background means he can coordinate and understand every stage of a project. Boshell joins the company from Jaga Heating Products.

Email info@dunham-bush.co.uk

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Call 0844 22 50 600, email justin.scofield@guntner.com or visit www.guntner.co.uk
Remeha provides first-class heating solution for Cambridge college

Four space-saving Remeha Gas 310 7-section Eco Pro boilers have doubled the heat output at Pembroke, one of the University of Cambridge's oldest colleges.

Robert Reeves, M&E consultant at The Energy Practice, specified the Remeha boilers because of their reliability, high output and small footprint. "The Remeha boilers achieve a reliable, compact solution to meet future, as well as current, demand at Pembroke College’s main site," he said.

The result, according to Robert Griggs, Pembroke’s buildings manager, is improved reliability, capacity, efficiency and, importantly, comfort for our fellows, students and staff.

Better safe than sorry with a Myson LST

There are several places – typically where vulnerable people are present – in which radiators with high surface temperatures cannot be used. In these situations, LST radiators are the ideal heating solution.

Myson’s range of LST radiators ensures that the surface temperature remains below 43°C, eliminating the risk of burns. Meanwhile, the radiators’ rounded edges minimise injury, making the range perfect for schools, nursing homes and social housing projects. They comply with NHS Estates Health Guidance Notes 1998, so homes and social housing projects. They comply making the range perfect for schools, nursing homes and social housing projects. Several have been installed in the educational, religious and manufacturing market sectors.

Call 01462 492 251, email commercial@idealboilers.com or visit www.idealcommercialboilers.com

Panasonic Pro Awards 2016 now open for entries

Panasonic Heating and Cooling has announced that the second Pro Awards, which celebrate industry excellence, are now open for entries. Installers, specifiers and consultants are invited to enter.

As well as gaining recognition and PR exposure, the winners will receive a Pro Awards 2016 trophy, plus a VIP trip to Panasonic’s headquarters in Japan.

The four main award categories for 2016 are: Best Residential Project; Best Hospitality Project; Best Retail Project; and Best Commercial Project – and the deadline for entries is 30 September.

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

Surface heating for new extension

Surface heating has been used in the extension block being built at La Sainte Union Catholic Girls’ School and Sixth Form College in London.

Oventrop Projects, on behalf of RN Plumbing and Heating, designed, supplied and installed a CoFloor tacker system, within a concrete screed, to the ground floor. It also installed a dry build system – comprising Knauf Earth wool in between the joists and CoFloor heat plates spanning the joists – to the first-floor drama studio.

Call 01256 330 441, email info@oventrop.co.uk or visit www.oventrop.co.uk
Polypipe ventilation achieves hat-trick at coveted product awards
For the fourth year in a row, Polypipe Ventilation has won in the Housebuilder Product Awards Best Services Product category – this time taking the top prize for its Domus Green Line, high-efficiency rigid duct bends.

The company also won the award in 2015 with its Domus Radial duct system, and in 2013 with its Silvent Green Line HRX mechanical ventilation with heat recovery system. In 2014, meanwhile, it was highly commended for its Domus Thermal duct system.

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

Green technology presentations by Powerstar
A series of free energy management events across the UK is being hosted by Powerstar, specialist in energy storage and voltage optimisation technologies.

The events are a mixture of geo-specific seminars and online webinars, which feature exclusive content only available to event attendees. Delegates can learn about the new energy storage system Virtue, and discover the range of Powerstar voltage optimisation technologies, and the savings that can be achieved.

Call 01142 576 5200, email events@powerstar.com or visit www.powerstar.com/events

Stop leaks fast with the ‘water stopper’ Vandex plug from Safeguard
The Vandex plug from Safeguard Europe – UK specialist in damp- and water-proofing and masonry repair solutions – is a fast-acting cementitious mortar that will stop leaks and seepage, and seal cracks in masonry, concrete, earthenware and stone in seconds. It can also be used as an installation mortar for fixings in wet areas, and even under water.

Examples for applications include plunging leaks in clay pipes, caulking tunnel segment joints and installing fixings in water structures requiring immediate use.

Call 01403 210 204

Rehau expands UK district heating production
Rehau is expanding the range of pipe sizes it manufactures in the Rauvitherm polymer district heating system, with the launch of 140mm- and 160mm-diameter options. This brings Rauvitherm into line with Rehau’s other pre-insulated pipework range, branded Rauthermex.

The new pipe sizes, available in 12m lengths, have been introduced for higher-volume installations. For example, the 160mm diameter pipe can be used for more than 3MW of heat through a single pipe at 80/50°C flow and return temperatures.

Email Jo.Trotman@rehau.com or visit www.rehau.co.uk

Addition to Hamworthy’s stainless steel range
Hamworthy Heating has announced the arrival of the Stratton mk2 wall-hung boiler. With the smallest output in the stainless steel family, the boiler is great for restricted-space plantrooms.

Keith Thompson, of Hamworthy Heating, said: ‘With improved pipework kits, the Stratton mk2 is lightweight and easy to install. It features an internal combustion non-return valve enabling it to fit into smaller spaces.’

Call 0845 450 2865, email sales@hamworthy-heating.com or visit www.hamworthy-heating.com

Sontay adds to its range of I/O modules
Sontay, manufacturer and distributor of sensing, measurement and control devices for intelligent buildings, has revealed the latest addition to its existing smart communication range – the SC-I0-24 I/O module.

The new I/O module can take inputs from standard field devices and transmit them over BACnet or Modbus protocols, offering a cost-effective solution for expanding I/O on an existing controller.

The SC-I0-24 I/O module allows the system to extend when it requires additional inputs and outputs on a physical controller.

Email sales@sontay.com or visit www.sontay.com

Product news from S&P
New high-efficiency heat recovery ventilation units for commercial applications are now available from S&P.

Models in the CADB-HE range come in horizontal and vertical configurations, and feature counter-flow heat exchangers, EC plug fans, ‘plug and play’ controls, integrated bypass, and a variety of heating options. There is a remote-monitoring option on all commercial heat recovery products to send a message when maintenance is required. Revit files are available.

Call 08454 700 074
Sauter ecos505: the ideal room controller for any system

The new ecos505 room controller from Sauter offers a single device to integrate all systems for room automation.

It provides demand-led control of room climate, lighting and sunshading, and is a freely programmable BACnet building controller. Combining DALI, KNX and SMI in a single device, the Sauter ecos505 can connect the sunshade, lighting and room-climate regulation systems to offer integral, energy-efficient room automation based on individual requirements.

The Sauter ecos505 works with remote ecoLink I/O modules.

Call 020 3786 2046 or visit www.sauterautomation.co.uk

Wieland’s Metalynx2 system makes the right connection at 30 Broadwick Street

Wieland Electric’s popular Metalynx2 modular wiring system was the preferred choice for power and lighting distribution throughout the recent refurbishment of 30 Broadwick Street, in Soho, central London.

Robert Biddle, of BAM Construction, said: ‘We required a system that could be delivered to meet our tight deadlines and Wieland’s Metalynx2 system fitted our brief perfectly. ‘Having a system arrive on site pre-tested and pre-wired allowed us to maximise the productivity on site.’

Call 01483 531 213

Comodo – heated bench seat convectors

Verano UK has developed a heated bench seat in two versions: 1m long, giving an output of up to 1,400W, and a 1.5m version, with an output of up to 2,250W. It is also expected in a fan-assisted version.

The standard Comodo bench seat comes in oak, but if your client is looking at other hardwoods, just let Verano UK know.

Ideal for school changing rooms, shopping centres, public waiting areas and airports, you can put your own logo in the toughened-glass panelled ends.

Call 0845 872 9537 or email eddy.warren@supaflex.com

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Operational Maintenance Manager

Vacancy Ref: L5X0002-1
Salary (Grade H4): £44,654 to £52,868 per annum incl. London Weighting

Brunel University London is a campus-based University situated in Uxbridge, West London, and is home to nearly 15,000 students from over 100 countries worldwide.

We are recruiting for a Maintenance Professional to lead the Direct Labour Maintenance Team as well as external service providers who carry out maintenance and repair works across the University. The main purpose of the role is to work with the Director of Estates to ensure that Maintenance Services are delivered to the highest possible standard for the benefit of students, staff and visitors. Duties include promoting a positive and pro-active approach and providing the skills, knowledge and application to produce an excellent service.

The successful candidate will have a background of leading and motivating a Direct Labour Maintenance team. They will have operational building, mechanical and electrical building services experience and be qualified to at least HNC/HND level in an electrical or mechanical discipline. Key to their success will be well-developed leadership, interpersonal and communication skills and clear customer focus.

Closing date for applications: Friday 23rd September 2016

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APPONNTMENTS

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REVIT MEP Coordinator £36 - £40 p/hour, Central London
We are working in partnership with one of the oldest Building Services consultancies in the UK to discover a REVIT MEP Coordinator. The project at hand is a large scale multi-storey commercial development in Central London. You will be required to coordinate the MEP services and produce and develop existing models. Ref: 3732

Managing Quantity Surveyor £60k - £75k + bonus + bens, Central London
A leading M&E Contractor are seeking an experienced Quantity Surveyor who’s looking to move into a Managing Surveyor position. Reporting to a Commercial Lead this role will facilitate a transition to oversee all commercial management and contracts management duties. You will be joining a highly experienced commercial team who are involved in build projects across London (and nationally). In addition to multi-million-pound frameworks for the coming years. A strong competitor against other well-known contractors - this company leads the sector providing an excellent working environment, salaries, benefits, and fantastic training and support at all levels. Ref: 3721

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Senior Mechanical Engineer £35p/h, West London
A London based independent design consultancy are looking to recruit a senior mechanical engineer. They provide design and management to some of the UK’s largest Aviation projects. You will have a minimum of 5 years’ experience and have excellent technical knowledge of mechanical engineering with the ability to deliver excellence. 9-12 Month contract. Ref: 3729

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CLEAR AS DAYLIGHT

The new president of the Society of Light and Lighting, Jeff Shaw, talks about his influences, projects and what he wants to achieve in his presidential year.

Jeff Shaw, who delivered his inaugural address as president of the Society of Light and Lighting (SLL) at City Hall, London, on 19 May, said he was a budding lighting designer even before he knew he could have a career in lighting. Now a lighting designer and associate director at Arup, his aims for his presidential year include inspiring the lighting designers and engineers of the future, and creating a legacy of engagement and interaction between the lighting and construction industries, and the public.

How did you start your career in lighting?
When choosing a degree course, I was interested in buildings, but could not decide between what I thought were my only choices at the time – architecture and structural engineering. So I did architectural engineering, which had a building services component, and I was immediately inspired by the lighting courses. This led me to get a summer internship with a New York lighting design practice – Cline Bettridge Bernstein Lighting Design (CBBLD) – during my studies. I then joined Arup as a graduate electrical engineer on the understanding that I would focus on lighting design, which I have done exclusively since we set up the lighting practice within Arup in 2001.

What/who is your biggest influence in the lighting sector?
Light in art, including current artists such as James Turrell and Leo Villareal, as well as those who worked with light in art and photography in the past, such as Dan Flavin and Man Ray.
Light is a key element of cinematography and storytelling, and films by directors David Lynch and Peter Greenaway have also influenced me. I have learned a great deal from all the designers I have worked for, too – both during my short internship at CBBLD, and over the past 20 years at Arup.

What is the most interesting project you have worked on?
Different projects are interesting for different reasons. I’ll remember my first completed project – a small office fit-out in London – because it was my first. Then there was the Prada flagship store in Tokyo – an award-winning design that I led. It was fascinating, with a very satisfying result.
The Tate Modern has been a big part of my life, working as a junior designer to help deliver the original project, and then spending eight years leading the lighting design for the new extension.

At the other end of the scale, working on the daylight design for a prototype school in a Malawi village has perhaps had the most socially beneficial impact.

What do you want to achieve in your year as SLL president?
I want to inspire the lighting designers and the engineers of tomorrow, and to let their parents know that a respectable career lies ahead for those who want to join our industry.
I also want to help create a lasting legacy of engagement and interaction between the lighting community, the construction industry and the public. Within these groups, I am aiming to develop an appreciation of what encompasses quality lighting, and demonstrate how lighting can impact on the world in which we live – particularly addressing current concerns about light and health.

We need to promote our message through public engagement and effective partnerships throughout our industry. I especially want to engage the younger generation through STEM Ambassadors in schools.

What is the biggest challenge for the lighting industry today?
The rapid technological advances from LED, which gives us more flexibility, but – at the same time – adds complexity to what we do.

What is the next new lighting technology to watch?
The pressure on the industry is from the Internet of Things (IoT) and Power over Ethernet (PoE) – the move to ‘smart’ lighting. There is potential in this to improve people’s experience of and interaction with a space through lighting – especially through control – but we have to ensure that the primary purpose of lighting is kept in focus.

Can lighting influence health and wellbeing?
Absolutely. The exact mechanisms of how it does so need much more research, which I want to ensure is happening. But there is no doubt that it can have a significant effect.

What advice would you give to someone considering a career in lighting?
Lighting is for people, who should be at the centre of what we do – and, remember, lighting is both an art and a science. It’s as much, if not more, about creative design as it is about lux levels – embrace both in your studies and training.

● JEFF SHAW is a lighting designer and associate director at Arup.
Events & training

**NATIONAL EVENTS AND CONFERENCES**

CIBSE Young Engineers Awards 2016
13 October, London
Comprising the Graduate of the Year and Employer of the Year prizes, www.cibse.org/yea

CIBSE Building Performance Conference and Exhibition
17-18 November, London
The annual conference returns to the QEII Conference Centre, with a programme that again promises to inform and inspire. Speakers include Max Fordham and Patrick Bellew. Visit the website for details of the full programme and to book. www.cibse.org/conference

**CPD TRAINING**

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

Mechanical services explained
7-9 September, London

IET wiring regulations
16 September, London

Energy efficiency building regulations
23 September, London

Earthing and bonding
23 September, London

Building services overview
27 September, London

Fire sprinkler systems: design
28 September, London

Building services explained for FMs
28-30 September, Birmingham

Gas safety regulations
30 September, London

Sanitary and rainwater design
5 October, London

**ENERGY ASSESSOR TRAINING**

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

Air conditioning inspector training
8 September, Sheffield

Heat networks
7-8 September, Manchester

LCC design and EPC
15-16 September, London

Air conditioning inspector training
20 September, London

LCC building operations and DEC
20-22 September, Manchester

ISO 50001: 2011 Energy management systems
26-28 September, London

Air conditioning inspector training
4 October, London

LCC design and EPC
4-6 October, Sheffield

Heat networks
5-6 October, Newcastle

**CIBSE GROUPS, REGIONS AND SOCIETIES**

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

SL& CIBSE South West: LG6
The exterior environment
8 September, Bristol

A talk by Alan Tullo, independent lighting consultant. Lux magazine technical editor and chair of the LG6 task group.

North East: Technical Meeting
13 September, Newcastle
Presentation by Ant Wilson from Aecom.

West Midlands: Part L and Metering
14 September, Birmingham
Technical CPD seminar.

Ireland: CPD 2 New form of contract and implications for M&E sector
14 September, Dublin
Presentation by Sean Downey, director, specialist contracting, at CIF.

HCNW and SLL: DIALux
14 September, Chilton St Peter
Seminar explaining how the BIM-oriented design software DIALux evo helps produce an integrated lighting layout.

SoPHE: Embedding acoustics into design
21 September, Manchester
A talk by Joanne Ansell, specification sales director, and Mari Milligan, of Geberit UK.

Lifts Group symposium
21-22 September, Northampton
Bringing together experts from the field of vertical transportation.

HCNW: Natural, and more than natural – trench heating in Milton Keynes
25 September, Milton Keynes
Seminar by Varano, coveing: natural convection; the evolution of trench heating; reasons to consider trench heating as a low-energy solution; design outputs and guidance; advantages and disadvantages; and fan-assisted versions.

HCNE: Membership briefing
27 September, London
Presentation for the Associate and Member grades, and registration with the Engineering Council at CIBSE.

HCNW: The HCNW debate
6 October, London
The annual debate, with expert panel. Topic and details to come.

West Midlands: Technical seminar on new lift standards EN81–20 and EN81–50
12 October, Birmingham
CPD seminar on new lift standards.

HCNW: Building physics and optimised design – by algorithm?
18 October, High Wycombe
A debate on current technologies and developments in BIM, looking at the possible trajectory where ‘deep learning’ and quantum computing may have the potential to automate building services design.

**SoPHE Young Engineers Awards presentation and AGM**

6 September, London

The winners of last year's Society of Public Health Engineers Young Engineers Award will present their winning design at the SoPHE AGM.

The team of Anokhee Shah, Anna Cesenni and Alex Bruce (pictured left to right), from Arup, won the award for their water-filtration design using the ‘miracle’ moringa plant as a natural aid to providing safe drinking water in Liberia. Their proposal involved the commercial growing of moringa plants, in conjunction with the establishment of water-treatment facilities, powered by bicycle and requiring little or no electricity to run.

Each facility could supply water for 150 people per day, as well as create jobs for local people. They could also produce a by-product of marketable goods, including fertiliser, seedcake for livestock, and oils used in cosmetics – so the treatment facilities could run at a profit.

The presentation comes just two months before the 2016 winners of the Young Engineers Award are announced in November.

For more information, visit www.cibse.org/sophe

CONFERENCE EARLY BIRD OFFER
Last chance to book at the early bird rate for the CIBSE Building Performance Conference and receive up to £70 discount.

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- Collaboration for Better Performance
- Digital Engineering & Building Services
- Innovation in Buildings
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- Refurb + Retrofit

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