



Kent Academic Repository

Schoenefeldt, Henrik (2016) *Question Time*. CIBSE Journal, 2016 (9). pp. 70-74. ISSN 1759-846X.

Downloaded from

<https://kar.kent.ac.uk/57095/> The University of Kent's Academic Repository KAR

The version of record is available from

<http://www.cibsejournal.com/archive/PDFs/CIBSE-Journal-2016-09.pdf>

This document version

Publisher pdf

DOI for this version

Licence for this version

CC BY (Attribution)

Additional information

Versions of research works

Versions of Record

If this version is the version of record, it is the same as the published version available on the publisher's web site. Cite as the published version.

Author Accepted Manuscripts

If this document is identified as the Author Accepted Manuscript it is the version after peer review but before type setting, copy editing or publisher branding. Cite as Surname, Initial. (Year) 'Title of article'. To be published in *Title of Journal*, Volume and issue numbers [peer-reviewed accepted version]. Available at: DOI or URL (Accessed: date).

Enquiries

If you have questions about this document contact ResearchSupport@kent.ac.uk. Please include the URL of the record in KAR. If you believe that your, or a third party's rights have been compromised through this document please see our [Take Down policy](https://www.kent.ac.uk/guides/kar-the-kent-academic-repository#policies) (available from <https://www.kent.ac.uk/guides/kar-the-kent-academic-repository#policies>).

CIBSE

JOURNAL



The official magazine of the Chartered Institution of Building Services Engineers

September 2016

HEALTHY ENGINEERING

How the Well Building Standard measures up in Cundall's London office

CUTTING THE WAFFLE

Services challenge of converting 1970s office tower into apartments

FEELING FREE

Comfort without air conditioning in an urban heat island

BIM. ACCURATE PIPE DESIGN

at your fingertips



FREE!

wavin

**REVIT CONTENT
PACKAGE**

Download
yours today!

FEATURING

- Quickest way to a complete 'as built' pipe system
- Precise designs with intelligent assistance
- Fully integrated Bill of Materials

Download now at wavin.co.uk/bim

wavin

CONNECT TO BETTER

Contents

NEWS

8 News

Brexit latest; Rise in STEM A levels; funding for apprentices; the gender pay gap; workers' worries over IAQ; and data could reduce cost of heat networks

14 CIBSE News

Prizewinners focus on impact of rising temperatures; heat networks Code of Practice; final call for Technical Symposium papers; networking bingo

OPINION

16 Feedback

Questioning emissions targets; CIBSE's LinkedIn group discusses the effectiveness of STEM education

18 The new Insurance Act

Hywel Davies on the implications of recent changes to insurance law

20 Designing buildings for people

Wellbeing in homes should be considered at design stage, argues Ashley Bateson

22 CHP and the UK's energy needs

William Orchard explains why heat networks fed by nuclear or fossil fuel CHP are better than ASHPs

60 If you don't test it...

Power cuts at data centres can be catastrophic, so how can you ensure you have supply when you need it?



David Boswell Reid pioneered POEs with Parliament ventilation system – page 70



Features

24 Making a world of difference

YEN's first global conference in Hong Kong

28 Concerted effort

How STEM ambassador Charity Nicholls used rock 'n' roll to inspire schoolchildren

30 COVER FEATURE A picture of health

The Well Building Standard at Cundall's office

36 Out of reach

Transforming a drab 1970s high rise office into a vibrant mixed-use apartment tower

42 Walking the talk

Building services within 20 Fenchurch Street

49 The perfect return

Why return temperatures are key in heat networks

SPECIAL FEATURES

● Air conditioning and ventilation

55 Inspections under scrutiny

Study of air conditioning inspection reports

62 In control

Architect AHMM tests thermal strategies in its London office

67 Book review

Refrigeration, air conditioning and heat pumps

LEARNING

77 CPD

Propane as a refrigerant for use in chillers for air conditioning applications

CLASSIFIED

82 Products

A round-up of systems and services for the industry

PEOPLE AND JOBS

87 Appointments

Jobs at jobs.cibsejournal.com

89 Q&A

Jeff Shaw, new SLL president, on his influences and what he wants to achieve in his presidential year

90 Looking ahead

Young Engineers Awards; CIBSE Building Performance Conference; CPD training; energy assessor training; CIBSE Groups, Regions and Societies

UNBEATABLY TOUGH.



THE NEW
HEAVY DUTY
PLANAR RADIATOR

It looks stylish, yet it's robust enough to withstand the knocks of heavy traffic in commercial environments.

And we're proud to say it's made in the UK.

*Our
best sellers*

K1, 450 x 800mm
£189.42*

K2, 600 x 600mm
£266.98*

 **Stelrad**® Designer Series

Find out more at **Stelrad.com**

*Prices exclude VAT



www.cibsejournal.com

Editorial

Editor: Alex Smith
Tel: 01223 378034
Email: asmith@cibsejournal.com
Deputy editor: Liza Young
Tel: 01223 378048
Email: lyoung@cibsejournal.com
Designer: James Baldwin
Technical editor: Tim Dwyer

Advertisement sales

Sales manager: Jim Folley
Tel: 020 7324 2786, jim.folley@redactive.co.uk
Sales executive: Darren Hale
Tel: 020 7880 6206
darren.hale@redactive.co.uk
Sales executive: Patrick Lynn
Tel: 020 7880 7614
patrick.lynn@redactive.co.uk
Senior sales executive: Paul Wade
Tel: 020 7880 6212
paul.wade@redactive.co.uk
Advertising production: Jane Easterman
Tel: 020 7880 6248
jane.easterman@redactive.co.uk

For CIBSE

Journal production manager: Nicola Hurley
Tel: 020 8772 3697, nhurley@cibse.org

Editorial advisory panel

George Adams, engineering director, Spie Matthew Hall
Patrick Conaghan, partner, Hoare Lea Consulting Engineers
Rowan Crowley, managing director, CIBSE Services
Chris Jones, Flakt Woods
Philip King, director, Hilson Moran
Nick Mead, engineering consultant
Jonathan Page, building services consultant engineer, MLM
Geoffrey Palmer, director, Sweco
Dave Pitman, director, Arup
Christopher Pountney, senior engineer, Aecom
Paul Reeve, director, ECA
Alan Tulla, independent lighting consultant
Ged Tyrrell, managing director, Tyrrell Systems
Hannah Williams, mechanical engineer, Atkins
Ant Wilson, director, Aecom
Terry Wyatt, consultant to Hoare Lea

CIBSE Journal is written and produced by CPL (Cambridge Publishers Ltd) Tel: +44 (0)1223 378000. www.cpl.co.uk
1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PB.

Editorial copy deadline: First day of the month preceding the publication month

Printed by: Warners Midlands PLC

The opinions expressed in editorial material do not necessarily represent the views of the Chartered Institution of Building Services Engineers (CIBSE). Unless specifically stated, goods or services mentioned in editorial or advertisements are not formally endorsed by CIBSE, which does not guarantee or endorse or accept any liability for any goods and/or services featured in this publication.

CIBSE, 222 Balham High Road, London SW12 9BS
Tel: +44 (0)20 8675 5211. www.cibse.org
© CIBSE Services Ltd. ISSN 1759-846X

Subscription enquiries

If you are not a CIBSE member but would like to receive *CIBSE Journal*, subscribe now! Costs are £80 (UK) and £100 (international). For subscription enquiries, and any change of address information, please contact Nicola Hurley at nhurley@cibse.org or telephone +44 (0)20 8772 3697. Individual copies are also available at a cost of £7 per copy plus postage.

The 2016 US annual subscription price is £100. Airfreight and mailing in the US by Air Business, C/O Worldnet Shipping NY Inc. C/O Air Business Ltd / 155-11 146th Street, Jamaica, New York, NY 11434. Periodical postage pending at Jamaica NY 11431. US Postmaster: Send address changes to *CIBSE Journal*, C/O Air Business Ltd / 155-11 146th Street, Jamaica, New York, NY 11434.

Cover image: Dirk Lindner



ABC audited circulation:
18,625 January to
December 2015



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 crash, 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 least 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.

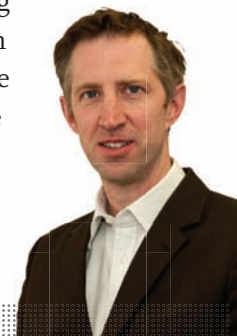
On the other side of the river is another prominent tower which has had challenges of its own. During construction of 20 Fenchurch Street sustainability credentials were somewhat put in the shade by the solar glare caused by its curved glass façade – which has since been rectified by the addition of south facing brise soleil. Hilson Moran's Vince Ugarow 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



A PROJEC END OF TH

And a piping system that supplies all of the e

With something as fundamental to the construction of an Arctic research station as the vital supply of warmth and clean drinking water, you don't experiment, but trust uncompromising quality and absolute reliability. Viega met these high demands using Sanpress Inox for drinking water and Prestabo for heating installation, and also delivered the know-how to go with them. **Viega. Connected in quality.**

Bharati Research Station, Antarctica

T AT THE E WORLD.

essentials right from the get-go.



viega

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.

MaF 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%.

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



Read about STEM Ambassador Charity Nicholls' work at a school on page 28

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'.

MOVING TOWARDS LOW GWP REFRIGERANTS

FREE SEMINAR - London 6.30pm Monday 24th October

KEY SUBJECTS

- Changing to flammable refrigerants
- Europe taking the lead
- HFC phase down, big drop in 2018

Suitable for building services engineers, HVAC engineers and commercial property owners / end-users.

To book your place visit our website: www.air-source.net



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.



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 (£7.2m); 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.

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 £648m – 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.

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.

Hoval

☎ 01636 672 711

✉ boilersales@hoval.co.uk

🌐 www.hoval.co.uk

Introducing the Powerbloc EG20... our smallest ever CHP

Responsibility for energy and environment

A tenth of UK electricity used for air conditioning

● In-depth BRE study reveals aircon energy use

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 policy 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 Mosey. 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 links 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 Bogotá, 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 United Nations Secretary General and funded by the Global Environment Facility.

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

● Real-time analysis reduces oversizing and saves energy

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'. He said designers currently used 'an outdated model' to calculate the maximum amount of heat needed at any one time, and this had led to 'networks being drastically oversized'.

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.

● See page 49 for more on heat network efficiency

DAIKIN FutureThinking

See into the *Future* of large-scale building systems design

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

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

Brought to you by **DAIKIN** **CIBSE**

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.

**“I’ve got enough
on my plate without
having to consider whether
we’ve chosen the right
contractor.”**

*Duncan
Pierce*

Duncan Pierce, Director,
Page Surveyors,
Building Surveyors

All ECA contractors undergo a thorough examination of their financial position as well as their technical skills; and their clients are protected by an insurance-backed warranty and bond.

**ONE THING LESS TO
WORRY ABOUT.**



To find an ECA contractor that's right for you, visit:
www.eca.co.uk



@EALive



/EALive



Electrical Contractors'
Association



Representing the best in electrical
engineering and building services

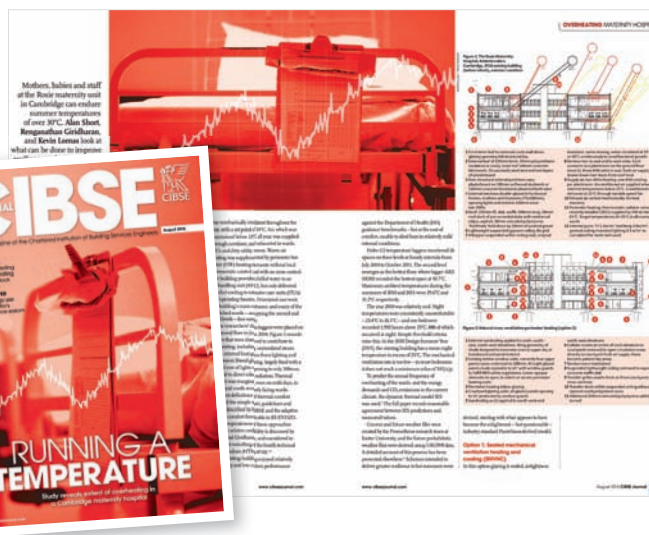
Awards for technical papers looking at impact of rising temperatures

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/2bfNEKz> 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-Institute 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



MANITSU / SHUTTERSTOCK

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 65m 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



From *CIBSE Journal*, August 2016

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.

Jens Haugaard

We need to make the job title 'engineer' mean what it says. The problem is that anyone who can drive a white van and wield a screwdriver or pipe wrench calls himself an engineer. I have worked for 10 years as a mechanical and electrical (M&E) design consultant, 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

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 Cowlrick

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.

6 This is plainly a near impossible target, if only because of what it means for per capita emissions for housing and building emissions

CIBSE Journal welcomes readers' letters, opinions, news stories, events listings, and proposals for articles.

Please send all material for possible publication to: editor@cibsejournal.com or write to: Alex Smith, editor, *CIBSE Journal*, CPL, 1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PB, UK. We reserve the right to edit all letters.



Lighting control in the palm of your hand



Vitesse Plus – Flexible. Reliable. Intuitive.

CP Electronics has built a global reputation for innovative, reliable, energy-saving lighting controls. Now the new generation Vitesse Plus system is even more adaptable and intuitive than ever. Saving energy costs and installation time.

The Vitesse Plus seven-channel system can be customised to almost any environment, from education to commercial and retail properties. The new built-in pre-set configuration menu allows you to set up your lighting control requirements quickly and easily. Advanced features like graduated dimming and corridor hold are also included. And like all our products, Vitesse Plus is backed by a five-year warranty and full technical support.

Controlling any light source, any building, any space.



Contact us today or visit www.cpelectronics.co.uk

T: +44 (0)333 900 0671 or comms@cpelectronics.co.uk

connect with us    



THISION® L EVO

THE COMMERCIAL BOILER REDEFINED



- Double helix coil minimises hydraulic resistance
- Up to 8 boilers in cascade - outputs to 1.1MW
- Gross seasonal efficiencies up to 97.1%
- NOx levels 39mg/kWh
- ΔT 30°C flow/return temperature differential
- Stainless steel heat exchanger for lifetime high efficiencies
- Outputs from 60-140kW



www.elco.co.uk
HEATING - HOT WATER - RENEWABLES



*Terms and Conditions apply

HOW TO ENSURE COMPLIANCE WITH THE NEW INSURANCE ACT

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

The Insurance Act 2015 (the Act) introduces three significant changes to the law on an insured party's pre-contractual duty to their insurers, and will apply to construction-related insurance contracts. The nature of the 'duty of fair presentation' has changed, as has the law concerning the knowledge of both the insured and the insurer in relation to fair presentation.

So what is a fair presentation of risk, according to the Act – and how might construction companies and their insurers be affected by it?

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 consultancy 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



What the insured 'ought to know' now includes the concept of a reasonable search

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.

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



The Caspian Universal LST. Feel so much better.

Caspian Universal LST is just what the doctor or the care home ordered! Flexibly sited high, low or ceiling-mounted, it's the ideal heating solution for any care home, health centre, surgery or clinic. Easy controls and great heat are a matter of good health!

Caspian Universal LST

- Plumbs into the central heating system
- One heating solution for a variety of applications - high, low or ceiling-mounted installation
- Free five year parts and labour guarantee
 - Made in the UK
 - Independently certified by BSRIA
 - EC motor technology



Call the Smith's sales office on:
01245 324900

Smith's
A Swan Group Company

25
1991-2016
Twenty-fifth anniversary

#ThinkSmiths #LST #Caspian #Healthcare

www.SmithsEP.co.uk

@SmithsEP_UK

DESIGNING BUILDINGS AS IF PEOPLE MATTER

The UK Green Building Council has released its latest report on health and wellbeing in homes. Hoare Lea's **Ashley Bateson**, who contributed to the document, summarises its findings and explains why wellbeing in homes should be taken into account at the design stage

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



More than 30% of homeowners would be willing to pay more for designs that consider health and wellbeing

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

CREDIT: ANDREW HAZARD



Mariner's Quay, Newport, Wales



engineers, housing developers and academics – to enable an integrated and eclectic review of the subject. Its findings are published in a report that can be downloaded at bit.ly/29tGMRT

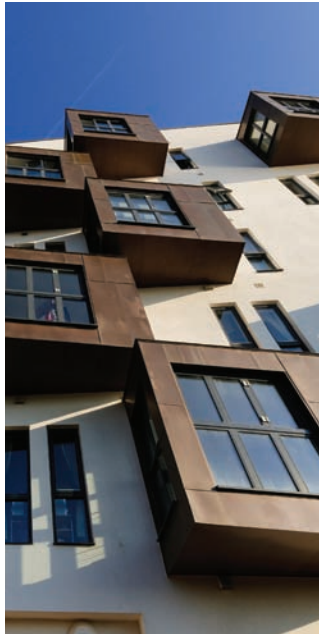
The UK-GBC's *Health and Wellbeing in Homes* report is part of an industry-wide effort to shift the market towards recognising the importance of the wellbeing of occupants – not just when they acquire their new home, but also in the long term, to ensure their happiness. It is an interdisciplinary, evidence-based review, showing the link between good-quality design and the wellbeing of residents and communities.

It is the third in a series of wellbeing publications led by UK-GBC, and follows previous reports on the subjects of health and wellbeing in the workplace and retail sectors. See betterplacesforpeople.org

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.

● **ASHLEY BATESON** FCIBSE is head of sustainability and partner at Hoare Lea



CONDAIR EL

New electrode boiler steam humidifier with longer lasting steam cylinder



The new Condair EL steam humidifier provides hygienic steam for in-duct or direct air humidification.

Due to its advanced water management, precise mineral levels are maintained in the steam cylinder, enabling it to last up to three times longer than some other electrode boiler humidifiers.

1hr
in-house
CPD seminars
available

Discover more about the Condair EL

www.condair.co.uk/EL
T: +44 (0)1903 850 200

Humidification and
Evaporative Cooling


The new name for JS Humidifiers

WHY CHP SHOULD MEET THE UK'S ENERGY NEEDS



Heat networks fed by nuclear or fossil fuel CHP are a better investment than air source heat pumps, according to consultant **William Orchard**

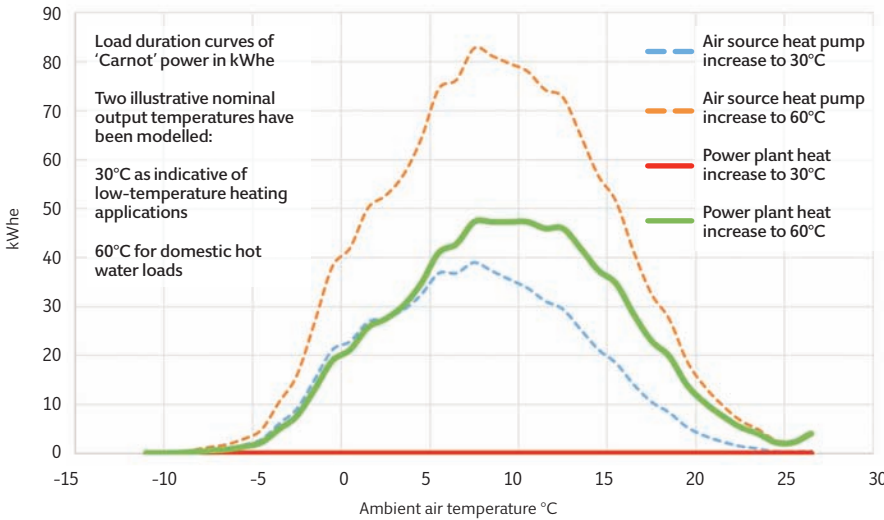


Figure 1: Comparing the energy required to deliver temperatures useful in buildings using electrical air source heat pumps compared with 'CHP virtual heat pumps' using heat at 30°C rejected from thermal power plants

networks. The heat networks could then connect with future nuclear CHP or gas-fired CHP fitted with carbon capture and storage.

Some recent Department of Energy & Climate Change (DECC) reports, and articles in *CIBSE Journal*, have suggested that electric heat pumps might be superior to CHP. However, CHP can be considered a 'virtual electric heat pump', as described by Professor Robert Lowe, who explained that CHP virtual heat pumps² have a coefficient of performance (COP) of 7, compared with the 3-4 of electrically driven heat pumps.

To resolve the differences of opinion about CHP and electric heat pumps, the 'Carnot analysis' can be applied (as shown below, left). By applying weather data, it's possible to determine (as shown in Figure 1) the energy required to deliver temperatures effective in buildings using electrical air source heat pumps (ASHPs) with ambient air as the heat source, compared with using heat at 30°C as rejected from thermal power plants.

In 2035, the UK is set to have 60GW of thermal power generation – so, assuming a nominal cost for electricity of 8p per kWh, the investment available for heat networks usefully to capture this otherwise wasted heat can be assessed, based on the savings available from using this higher temperature heat source.

As an example (Table 1) shows the cost of using an ASHP to produce 1kW heat over a whole year to deliver a temperature of 30°C, assuming a Carnot COP. This cost (above that of using 30°C heat directly from thermal power stations) is then converted into a capital investment value delivering a 3.5% per year real rate of return, over a nominal 100-year lifetime (the life of the alternative pipe network). Using the resulting figure £1,305 per kWt and using 60GW of available heat, then £78.3bn can be invested in the heat infrastructure.

In our paper to government in 2008, we estimated that a 140km line of 2m-diameter pipes cost £425 per kW of capacity, and that local pipes to serve 3,840 Edwardian, 24kW dwellings cost £475 per kW of capacity, giving a

As far back as 2008, in a report to the UK government,¹ Orchard Partners pointed out National Grid's vulnerability to disruption. The report proposed that priority be given to installing 20,000 local, dual fuel, 500kW combined heat and power (CHP) plants that would connect at the 11kV/415V interface, feeding heat and power to towns and cities to avoid blackouts. This was estimated to be the cheapest way to provide backup to wind power and a low carbon heat source for heat

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)

$$\frac{T_h - T_c}{T_h} \times 100\%$$

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.

total of £900 per kW of capacity. This indicates that heat networks are a better investment than ASHPs (drawing their heat from the ambient air) at a cost of £1,305 per kW of capacity.

Ideally, 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 report³ 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 **CJ**

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/2bEiumy
- 3 EU Emissions Trading System: Benchmarking as an allocation methodology for heat bit.ly/2bRSkff
- 4 EU Emissions Trading System: Benchmarking as an allocation methodology for heat from 2013, bit.ly/2bUZ7HF

WILLIAM RH ORCHARD MCIBSE is managing director of Orchard Partnerships

There should be a structure that includes gas and electricity networks, financed by consumer investment in ‘heat network bonds’

Heat pump technology	Delivered temperature °C	Electricity cost £/kWt per year	Justified capital investment £/kWt
Air source heat pump	30	47.2	1,305
Power station reject heat	30	0	

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

TRUST MULTIKWIK TO GIVE YOU MORE



The Multikwik range also includes sanitary frames, concealed cisterns and flush plates – all of the hidden things that offer reliability when designing modern washrooms.

For more information on the complete product range, visit the new Multikwik website.



multikwik.com

an *O*Aliaxis company

TRUST MULTIKWIK

MAKING A WORLD OF DIFFERENCE

As the November Young Engineers Network Award approaches, **David Mather** and other delegates reflect on YEN's first global conference in Hong Kong

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



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. **CJ**



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?

Do it without question; over the past few years I've gone from organising local events for 20 people to travelling to the other side of the world and representing the institution and my

profession internationally – what more could you want?

How does your employer benefit from your involvement with YEN?

They don't necessarily see direct business benefit; however, since the trip, I have been more inspired and motivated to expand my horizons at work and beyond – and a happy worker is a productive worker!



Sophia Wing

Mechanical engineer, WSP Parsons Brinckerhoff, and CIBSE YEN South West chair

What was the most inspiring thing about the visit to Hong Kong?

After overcoming the scale of the skyscrapers in Hong Kong and the casinos in Macau, I learned that here design consultants of building services systems have an ongoing presence on site, to ensure optimum efficiency and operation of the plant – something that seems invaluable when we strive to have a more sustainable approach to design. We should inherently be aware that building design doesn't stop at handover.

What did you learn from other YEN members?

It was encouraging to meet so many of my contemporaries – who have a great enthusiasm for YEN – and get their insight into the best way of engaging with the region.

How different was Hong Kong from your home country?

Geographically, Hong Kong is very different from the UK, and this has a huge influence on the built environment. Only 35% of the

territory's landmass is developed. Unlike the UK, where there is a horizontal sprawl between towns, Hong Kong is built vertically to make the most of its precious land.

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.



David Mather,

JDP and CIBSE YEN London chair at time of visit, now senior mechanical engineer at Peter Brett Assoc, and CIBSE YEN vice-representative

What was the most inspiring thing about the visit to Hong Kong?

The technical site tour of the EMSD Kai Tak district cooling plant was particularly interesting. With a capacity of 284MW of cooling, the project is larger than London's Olympic Park, which has 46.5MW of district heating and 16MW of district cooling. Kai Tak is to be connected to a development of around 60 buildings on a single brownfield site.

What did you learn from other YEN members?

That the role of building services engineers



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 life-cycle of buildings, and the energy efficiency gains available through managed operation and well-designed controls.



Carla Bartholomew
Senior mechanical engineer, Arup, and YEN CIBSE Council representative

What was the most inspiring thing about the visit to Hong Kong?

The enormity of the skyscrapers, and the individuality buildings; we were having dinner on the 13th floor of the Mega Box – which looked out over the city – and I was in awe of how each building created its own stamp on the cityscape.

What did you learn from other YEN members?

How business is done in other countries, and the expectations of young engineers. In Hong Kong, it is a lengthy process for engineers to develop and gain esteem, often long after they have obtained chartership. Whereas in the United Arab Emirates, for example, there is a bigger drive for young engineers to take up senior positions earlier in their career, when they are given more responsibility.



Some of the delegates at the 2015 YEN Global Conference in Hong Kong

How different was Hong Kong from your home country?

I liked the respect and appreciation that young people in Hong Kong have for their seniors – a trait we are losing in British culture.

What would you say to others thinking of joining YEN?

Not just YEN, but the industry in general will give you an incredibly diverse career and open up opportunities for working internationally. It will help you to make a difference.

How does your employer benefit from your involvement with YEN?

The conference, which I organised, has given me professional confidence, as well as an understanding of different business practices.

An employer’s view

JDP on how David Mather benefited from the Hong Kong trip

We thought the CIBSE YEN Conference would help David learn about the approach to M&E design in another country, potentially inspiring him to come up with fresh ideas.

Dropping him into a different business environment should both challenge and reaffirm the ideas he has developed throughout his career and education.

The conference programme and the opportunity to network with other young engineers from around the world would also allow him to reflect on his knowledge and help build his confidence further.

We try to develop our young engineers into rounded individuals, so we realised this experience would benefit both David and JDP – and, ultimately, our clients. CJ

For more blogs from the CIBSE YEN Conference visit <http://bit.ly/2bnw77e>

THANK YOU

The delegates would like to express their gratitude towards all of the sponsors, supporters and contributors, including employers and the volunteers in the CIBSE Hong Kong Branch and YEN centre.



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.

Gas fired condensing
commercial boilers,
now available

off the shelf

for next day delivery



The New Condens
FS 300/600 series of floor standing
boilers with unique Al-Si-Mg heat exchanger.
Available in outputs from 69kW to 542kW
and a total cascade capacity of 8,672kW.



Because progress needs to happen now

Energy efficient heating is at the heart of every building project. Ferroli Commercial designs and manufactures some of the most innovative boilers available today and many of them are available for next day delivery from our UK head office.

Advanced, versatile, highly energy efficient and ready to go – contact us today to find out which Ferroli Commercial boiler is exactly what you need, right now.

ferroli
Commercial

Ferroli Limited Lichfield Road Branston Industrial Estate Burton-upon-Trent Staffordshire DE14 3HD
T 0330 205 0002 E commercial@ferroli.co.uk www.ferroli.co.uk



CONCERTED EFFORT

When STEM ambassador **Charity Nicholls** mentioned 'building services engineering' to a class of pupils, she was met with a sea of blank faces. In response she created a virtual rock venue and, with the help of Google's 3D glasses, brought the profession to life

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

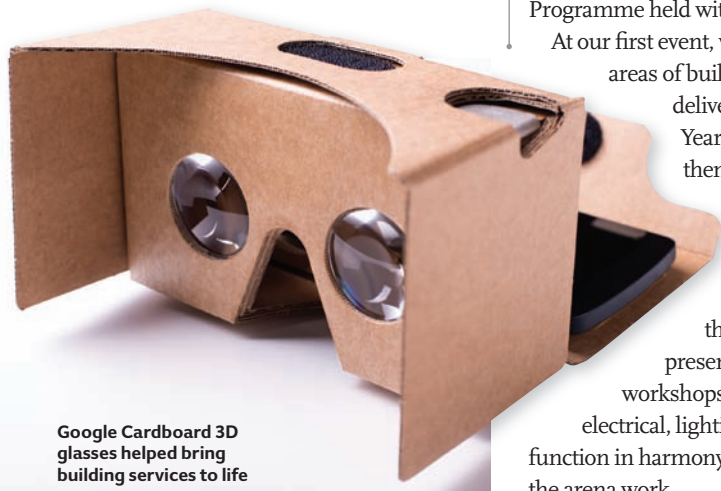
The back-of-house area of the concert arena needed to be ventilated properly, so that changing rooms and practise rooms would all be comfortable for occupants. Using a table-top model of the area with a fan attached, students released smoke pellets from the 'plantroom'. They then had to open ductwork 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.



Google Cardboard 3D glasses helped bring building services to life



“ 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?

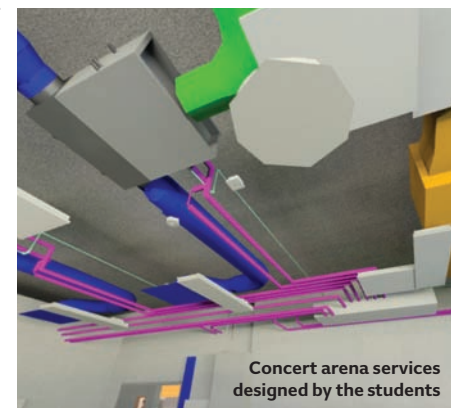
Afterwards, they looked at a creation through Google Cardboard glasses to get a 3D-visualisation of the space. The feedback was very positive, with students enjoying the interactive sessions and virtual reality.

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/



The perfect combination..... P-Sensor and the CMR Velogrid



VELOGRID
Velocity Averaging Sensor



P-Sensor

CMR are the inventors and manufacturers of both the P-Sensor and the Velogrid. The Velogrids are made to measure to fit any ductsize up to 3m x 3m and the P-Sensor has a keyboard to easily enter : duct height - width - density - magnification factor and the scaling in m/s - m³/s - m³/h - l/s. It can even work out the Air Change rate. And the BMS gets three linear volume signal outputs of 0..10V 4..20mA and an addressable Modbus rtu bus.

CMR CONTROLS Ltd

22 Repton Court Repton Close
Basildon Essex SS13 1LN GB
www.cmr-controls.com


Tel +44 (0) 1268 287222
Fax +44 (0) 1268 287099
sales@cmr-controls.com





A PICTURE OF HEALTH

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

 PROJECT TEAM

- Client: Cundall
- Architect: Studio Ben Allen
- MEP engineer: Cundall
- Contractor: QOB Group
- Project manager: HUSH
- Quantity surveyor: Bigham Anderson Partnership

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

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, NO_x, ozone, CO₂, temperature and



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.

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

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/2bArnOU>).

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



Plants are integral to maintaining air quality



says: 'It is fundamental that air is drawn through the root system, where the microbes break down particulate matter.'

Water

Cundall has committed to testing its water quality on a regular basis, including inspections of filters and coils. Because of the high nickel content – and other contaminant – in its water, Well insists on the installation

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.'



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.

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

Future trends

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.'



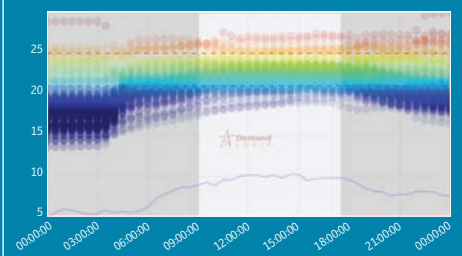
THE IMPACT ON PRODUCTIVITY

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:

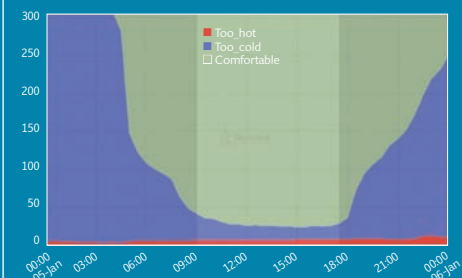
999 x £41,000 x 1.5 = £61,438,500
 So the estimated total annual loss because of temperature-related discomfort is:
0.0024 x £61,438,500 = £146,000

Thermal profile over time



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

How many spaces were uncomfortable throughout the day?



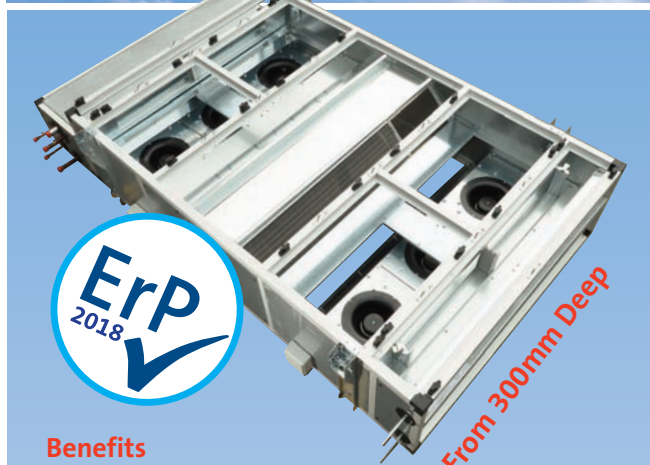
The red area shows how many spaces were too hot, and the purple shows how many were too cold

AIR HANDLERS LTD

PVHRU

Max Quiet

Packaged Void Heat Reclaim Unit



Benefits

- Low profile from 300mm deep.
- Up to 90% Heat Recovery efficiency.
- Outperforms ErP 2018.
- Heating Coil options. LPHW or electric.
- Cooling coil options chilled water or DX.
- Heat pump coil options.
- TM52 compliant.
- On board controls available.
- Filtration to F7.
- Summer by pass facility.
- High sound reduction casework tested to BS EN ISO 10140-2 (2010) UKAS certified.
- High performance backward curved centrifugal fans with low specific fan power.
- Meets BB101 and BB93 Feb 2015.
- Bottom access.



Air Handlers Northern Ltd.
 Alfred Procter House
 Bute Street, Salford
 Manchester M50 1DU



Acoustic Testing Laboratory
 College of Science & Technology

University of Salford
MANCHESTER

Tel: 0161 745 8888
 Fax: 0161 725 9900
 sales@airhandlers.net
www.airhandlers.net

Engineering Solutions



– 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**

Need to chill?

There's a Geberit for it.



**KNOW
HOW**
INSTALLED

Chilled water and refrigeration applications require a safe solution for carrying water, gases and other cooling media to the air handling unit to then distribute through either an air conditioning unit or chiller. Geberit Mapress Copper, Stainless Steel and Carbon Steel are suitable materials for such application, providing a tried, tested and trusted seal.

→ www.geberit.co.uk/forallapplications



OUT OF REACH

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

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 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



PROJECT TEAM

- Client: CIT
- Architect: KPF
- M&E consultant: Sweco
- Main contractor and M&E contractor: Mace
- Structural engineer: AKT II



building's existing floorplates. These were built using a concrete ribbed-and-waffle slab construction – a technique popular in the 1970s. This form of construction comprises a grid of hundreds of identical waffle pots, each resembling an inverted cake tin, assembled to form a floorplate with waffle-shaped indents on its underside. Each waffle pot measures 800 x 800mm and, at their ribbed edges, are 380mm thick – but their dished profile means they are thinner towards the centre.

The biggest challenge with this form of floor construction was that the project's structural engineers, AKT II, would only allow penetrations through the floor slabs in the central 630 x 630mm area of each waffle pot.

Dealing with these constraints was a particular problem when it came to developing a drainage system for the apartments. 'Without a doubt, the biggest challenge has been battling the structure to position the vertical drainage stacks to meet the architect's aspirations,' says



The tower's ribbed-and-waffle slab construction made it hard to develop a drainage system for the apartments

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

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.

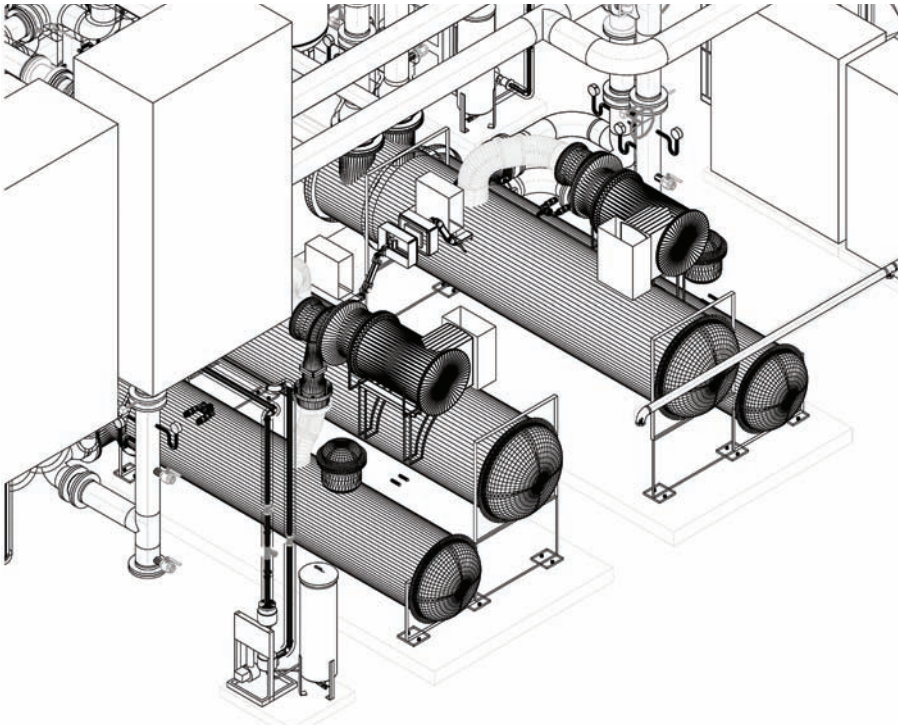
The boilers and chillers are located in the scheme's basement energy centre, and heating and cooling pipework is routed up through the building's central core, with distribution to individual floors and apartments. Because the tower is 160m high – and pressure in the vertical pipework increases by approximately 1bar for every 10m in height – the design incorporates heat

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

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



Above: 3D view of chillers in energy centre. A cooling capacity of 3,600kW is provided by water cooled centrifugal chillers, with heat rejection via roof-mounted cooling towers. The 60m³ thermal store keeps the CHP operational for longer periods of time. The stored water is used to service the heating and domestic hot water demands across the development

drilled in the structural core were in precisely the right position – too many holes, or holes drilled in the wrong position, would have weakened the structure,’ Hale explains.

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.

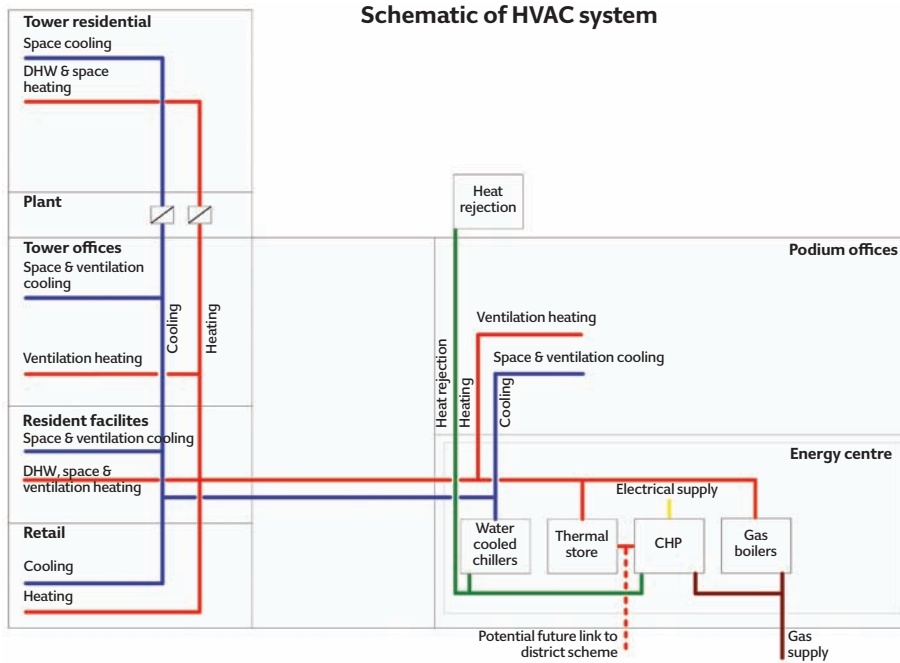
Sectional completion

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



The adjacent T-shaped podium office building

three modules. 'The boilers had to have a good turndown 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

~~Combined~~ Optimised Heat and Power...



...for maximised CHP % share



LoadTracker CHP

www.sav-systems.com



Celebrating 10 years
showcasing the best in
building performance



FINAL CALL FOR ENTRIES

ENTRY DEADLINE: THURSDAY 15 SEPTEMBER 2016

FREE
TO
ENTER

2017 CATEGORIES FOR ENTRY:

RECOGNISING TEAMS

- › Building Performance Consultancies of the Year
 - Up to 100 employees
 - 101-1000 employees
 - Over 1000 employees

CELEBRATING ENGINEERING EXCELLENCE

- › Projects of the Year
 - Commercial /Industrial
 - Leisure
 - Public Use
 - Residential
 - Retail
 - International
- › Lighting for Building Performance Award

REWARDING PRODUCT DEVELOPMENT

- › Products or Innovations of the Year
 - Energy Saving
 - Energy Efficient

SHOWCASING INNOVATIVE INITIATIVES

- › Building Performance Training Programme Award
- › Collaborative Working Partnership Award
- › Energy Management Initiative Award
- › Facilities Management Team Award

SIMPLE
ONLINE
ENTRY
PROCESS



BUILDING PERFORMANCE AWARDS BENEFITS OF ENTERING

- Reach an international community of 38,000 CIBSE members and contacts
- Feature in the CIBSE Journal circulated to 19,000
- Exposure to an audience of over 700 awards dinner guests
- Potential for press coverage in national and trade press
- Recognition for team success
- Celebration of achievements alongside the best of the best in building performance

For more information on the award categories and how to enter, visit www.cibse.org/bpa

“ Being able to say we are a multi-award winning firm is something that makes us stand out within the marketplace, as does the publicity and heightened awareness that stems from such prestigious wins. ”

Brian Morris, Managing Director, Beverley Clifton Morris

2016 winner of Building Services
Consultancy of the Year
(up to 100 employees)



ENTRY DEADLINE:
THURSDAY 15 SEPTEMBER 2016

FIND OUT MORE AT:
www.cibse.org/bpa

 @CIBSEAwards
#BPA2017

Sponsorship enquiries please contact jim.folley@redactive.co.uk or 020 7324 2786

Sponsored by

Power and productivity
for a better world™



WALKING THE TALK

Collaboration and investment in innovative technology were key to creating one of the City of London's greenest new towers, says Hilson Moran's **Vince Ugarow**

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



PROJECT TEAM

- **Architect:** Rafael Viñoly
- **Client:** Land Securities/Canary Wharf Group
- **Building services engineer:** Hilson Moran



LANCIE BELLEYS / SHUTTERSTOCK



Plant space in 20 Fenchurch Street



The building has 14 double-deck lifts

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

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

Specifications

- 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

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,



VALDIS SKUDRE / SHUTTERSTOCK



Stand-out BIM

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

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.

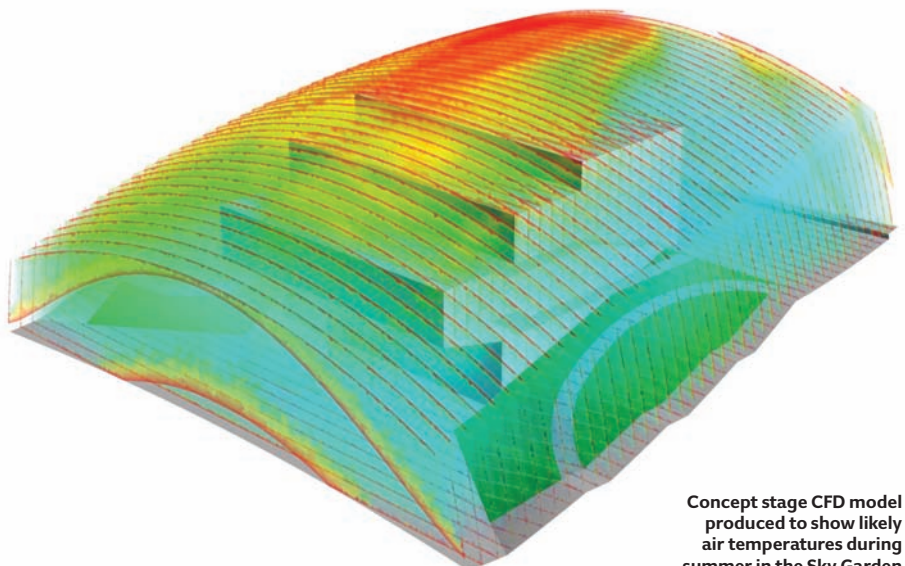
Roof-mounted photovoltaic panels generate around 27,300kWh a year. The system was designed so that the fuel cell and the building can be connected to a city-wide heating and cooling network in the future.

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'.

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



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

Welcome to the
First Class Section.
Where light travels
in LED style.



Our new LINEAR LINES LED range has three different profiles, each offering its own twist on the way light is presented and distributed.

Each design uses a torsionally stiff, solid aluminium extrusion, ideal for easy heat dissipation. This is important when utilising high performance LEDs.

RIDI's own LED boards are mounted using a sturdy aluminium plate and can be specified in a choice of outputs.

The design allows easy adaptation for specials such as illuminated L-shaped corner pieces. With LINEAR LINES, light can easily travel round corners.

Direct or indirect light. Or both.

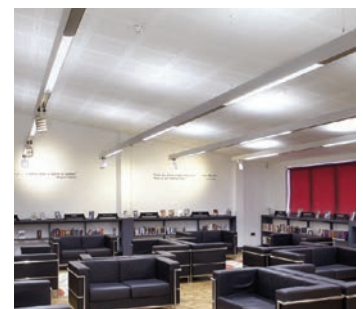
Even illumination of opal or prismatic optics ensures a smooth spread of light across the diffuser making shadow and glare-free lighting easily achievable.

Individual, project-specific options.

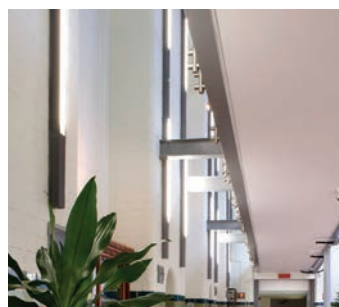
LINEAR LINES comes in any reasonable length, finished in anodised silver or painted in a range of RAL shades. RIDI Smart Control, specified as an option, enables Bluetooth operation via an App.

It may still prefer to go in straight lines but with RIDI LINEAR, LED light travels in undeniably impressive style.

RIDI H-Line in use at Invicta College.



RIDI U-Line Inventive use of LED lighting at Rugby School.



RIDI Venice brings a fresh take on LED style.



RIDI

5-star service
German engineering
No extra cost

RIDI Lighting Ltd 8/9 The Marshgate Centre CM19 5QP
info@ridi.co.uk Tel: +44 (0) 1279 450882 www.ridi.co.uk

Roof-mounted photovoltaic panels generate around 27,300kWh 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.



DANIEL VINE PHOTOGRAPHY / SHUTTERSTOCK

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. **CJ**

VINCE UGAROW is director at Hilson Moran



DAIKIN APPLIED (UK) LTD

The highest peak in chiller technology, the new VZ Inverter Water Cooled Chiller...*Technically better*

The new Daikin Applied inverter VZ water cooled chiller delivers the highest efficiency in its range. With a small footprint, low noise level and wide operation range, the VZ chiller can be used for a variety of applications. Including Data Centres, Thermal Storage, Heat Pump and Comfort Cooling.

- Top Class efficiency: ESEER up to 8.5
- Wide Capacity range: 450kW to 2100kW
- Flexible design: Up to 1MW single circuit, 2.1MW dual
- Quiet operation: down to 66 dBA
- Compact design: only 900mm wide



- AHUs
- CHILLERS
- PROJECTS
- SERVICE

North: 01670 566159 South: 01322 424950 www.daikinapplied.co.uk



BY HEATRAESADIA

DOMESTIC LIFETIME WARRANTY	COMMERCIAL 30 YEAR WARRANTY	MADE IN THE UK
LIFE TIME	30	



Quality. Guaranteed.

Our wide range of Megaфло cylinders give outstanding and unparalleled levels of hot water performance, exceptionally fast recovery rates and energy-saving economy.

Faster, simpler installation.

Lightweight duplex stainless steel construction with pre-plumbed and pre-wired solutions.

Lifetime warranty†

Including free on-site service support from our award winning customer support team.

A solution for every home.

A wide range of energy efficient cylinders including Solar and SystemReady, with powerful flow rates for outstanding performance.

Supporting you.

Our very own specification and after sales team to assist you every step of the way.

£150 with every Megaфло*

Our Megacash offer means you get £150 cashback with every Megaфло you install.

For more information

01603 420220 | enquiries@megaflo.com

www.megaflo.com

†30 years in commercial installations *Terms and conditions apply, all enquiries to be directed to enquiries@megaflo.com

BUILDING HIGHER PERFORMANCE

IN COMMERCIAL BUILDINGS

THE BENEFITS OF INTELLIGENT PUMPS ARE CLEAR:

- Highest energy efficiency due to intelligent control
- Optimal operation via multiple control modes
- Intelligent pump operation increases reliability and prevents system stress
- Lower energy consumption and total system cost
- Communicate with your smartphone or BMS system for faster setup, commissioning and diagnostics



INTELLIGENT PUMPS ENABLE HIGHER PERFORMANCE IN YOUR SYSTEMS

In every high performing building there is a high performing pump. But pumps are only part of the story. Intelligent solutions allow you to take control of your entire system to achieve an even higher performing building. Intelligent control modes allow Grundfos pumps such as the MAGNA3 to automatically adjust to the most critical system demands. This ensures optimal temperature, flow and pressure without compromise.

Discover more at www.grundfos.co.uk/magna3

be
think
innovate

GRUNDFOS 

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.¹ 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. ➤

For a heat network to be energy efficient, it is essential that low flow return temperatures are achieved. Carbon Alternative's **Martin Crane** explains why it is so important

THE PERFECT RETURN



➤ The heat network return temperature is determined by individual return temperatures from five processes: domestic hot water (DHW) generation; space heating system; plant – for example heat interface units (HIUs) – operation when at no load; action of any bypasses on heat network; and heat exchangers on the heat network.

In residential schemes the HIU usually sets the DHW and standby return temperatures. For DHW, cylinders need to be avoided because stored DHW needs to be at 60°C to prevent legionella, and it needs sophisticated controls and commissioning to achieve a below 60°C return temperature when heating a cylinder to 60°C. In Scandinavia, 50°C is an accepted temperature from an instantaneous DHW heater and should usually be able to generate below 30°C return temperature with virtually no commissioning required.

To improve the understanding of HIU performance, DECC research funding was used to develop an HIU test.² The testing details the performance of the DHW generation, DHW delivery and standby operation. The tested HIUs are from the UK's largest suppliers, and figures 1 and 2, right, show their performance on the test rig. The key test results are the volume weighted average return temperature (VWART). The figures show the VWART for the DHW, standby and space heating. From these, an overall VWART is calculated to represent the combined average return temperature, based on a typical mix of DHW and space heating. Instantaneous DHW generation from an HIU tends to lead to low DH return temperatures. But there are variations between HIUs.

For space heating, the test assumes a good radiator setup that operates at 70/40°C, but there was quite a variation between HIUs, all developing temperatures much higher than the 40°C secondary return temperatures. In practice, the return temperatures are commonly even higher than this as it is currently rare in the UK to see radiators commissioned to achieve return temperatures as low as 40°C. In the UK, we need to follow Scandinavian experience and use pre-settable TRVs that set the radiators flows low enough to achieve 40°C return temperatures.

The standby VWART showed the greatest variation between HIUs, because of the range of approaches manufacturers take to ensure the HIU is kept warm to enable a rapid supply of DHW. Key questions arising are: how fast should DHW be delivered? What is the heat loss penalty for faster DHW delivery? What is the optimum balance between the cost of additional heat loss and faster DHW delivery?

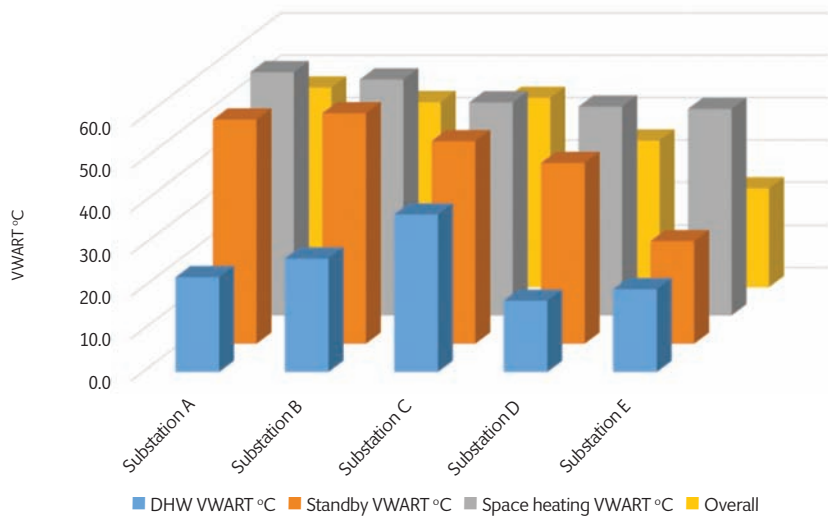


Figure 1: Variation in HIU performance in terms of volume weighted average return

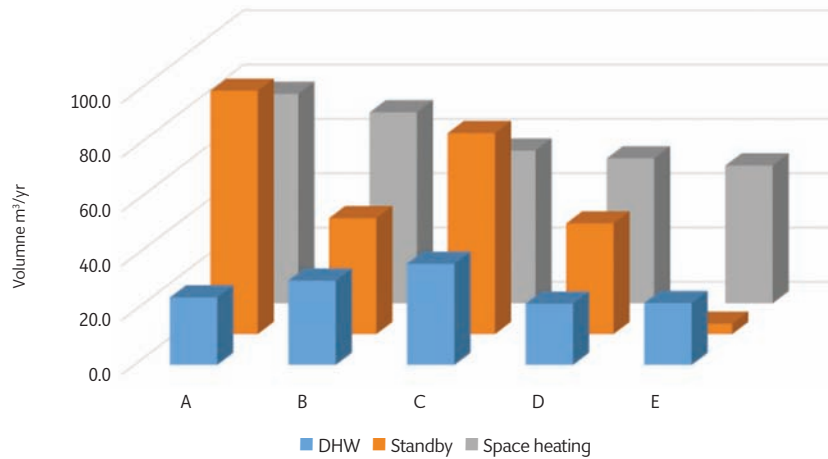


Figure 2: Annual volumes through an HIU over the year

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

Designers and specifiers need to understand HIU performance better, to ensure the HIUs installed and commissioned deliver the lowest return temperatures

Viega press systems

One connection technology for all installations.

For secure and clean gas installation:
Viega Profipress G

The cold pressing technique for thick-walled steel:
Viega Megapress

Stainless steel for optimal hygiene in drinking water installation:
Viega Sanpress Inox

For special applications in the high temperature range:
Viega Profipress S



Cost-effective: Externally galvanized steel for heating installation:
Viega Prestabo

Perfect for drinking and heating water installation:
Viega Profipress

Reliable: Gunmetal for use in building services:
Viega Sanpress

viega.co.uk

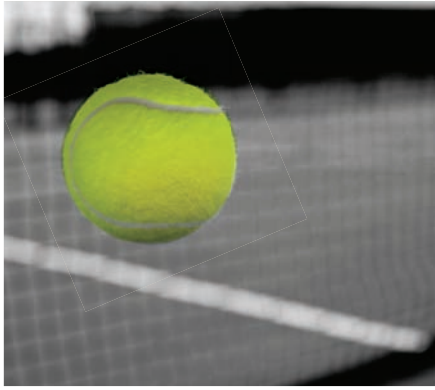
Unbeatable in practice

A single press tool is all you need for quick, clean connections. The function of the SC-Contur ensures that unpressed connectors are 100% leaky and immediately identified during a pressure test. This ensures the highest possible installation security and the extensive range of product solutions on offer has every practical application covered. More information: Viega Ltd 200 Brook Drive · Green Park · Reading · RG2 6UB · Tel: 0330 111 4568 · sales@viega.co.uk



Pressgun 5

viega



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 learning from operating schemes. Data exists showing that a typical peak diversified heat load for a new London flat is 2.5kW³ and that an HIU delivering DHW can generate a delta T of up to 60K (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/2bNjLL1>) can help address these and other key issues. **CJ**

References:

- Using data to optimise heat networks pp34–36, *CIBSE Journal*, May 2016 <http://bit.ly/2brtf9K>
- HIU heating, Fairheat <http://bit.ly/2bim0jq>
- 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 turndown 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

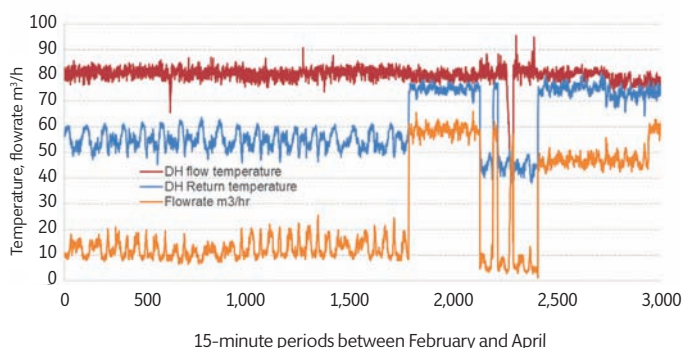


Figure 3: Heat network flow rates and return temperatures, after connection of new building with open bypasses (SSE, BMS data Royal Arsenal Riverside Woolwich, Feb - April 2011)

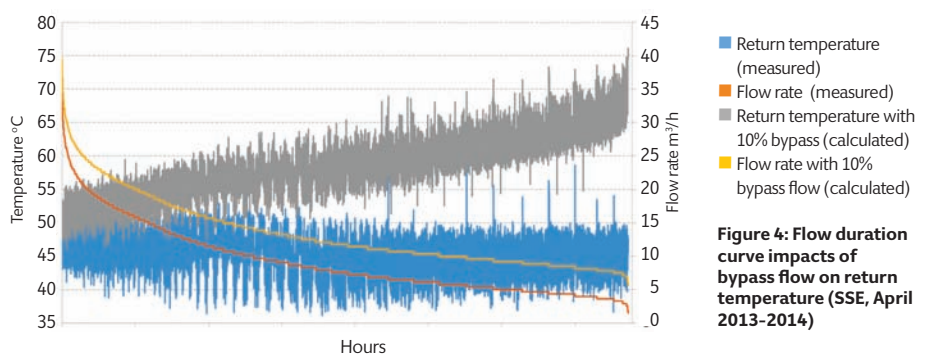


Figure 4: Flow duration curve impacts of bypass flow on return temperature (SSE, April 2013–2014)

Larger spaces to heat?

We've got some big ideas.



ecoTEC 46kW and 65kW high output boilers.

Let's face it, size matters. So when you need heating systems for large houses, schools, community halls and commercial spaces, it's time to think big.

Vaillant's ecoTEC 46kW and 65kW wall hanging high output boilers pack the power to heat larger spaces in no time. Handily, they feature the same ecoTEC components and controls that you're familiar with in domestic installations. Even better, you can fit these light commercial ecoTEC models with your existing domestic qualifications.

What's next? Book your free training place:

For more about installing the ecoTEC 46kW and 65kW boilers, and even larger ecoTEC outputs, Vaillant offers free training courses for domestic and commercial installers.

Find out more and register today at vaillant.co.uk/commercialboilers

The good feeling of doing the right thing.



■ Heating ■ Hot water ■ Renewables

Because  **Vaillant** thinks ahead.

Envirofresh 70 Quiet

Low Energy, Air Source Heat Pump System,
Silenced with Acoustic Treatment as used
in Hundreds of Projects

Envirofresh 70 **Quiet**

Out Performs



Benefits

- Meets TM52 for Schools
- Meets BB93 Feb 2015
- Renewable Energy Source
- BMS Controls Installed in Unit
- Factory Pre-Commissioned
- Low Energy Consumption
- Reduced Site Installation Cost
- Heating and Cooling from One Source
- 50% Less CO₂ Production than a Gas Boiler
- No External Condensing Units, Pipework or wiring
- Low Noise Emissions with Silenced Compressors
- Tempered Air Supply without Defrosting
- No Increase in Footprint over Standard AHUs
- No Loss of Heating Capacity at Low Temperatures
- High Specification UKAS Certified Low Breakout Casework
- Room Heating and Cooling available at Reduced Air Volumes
- More Pleasant Appearance than Condensing Unit or Chiller Installations



University of
Salford
MANCHESTER



Air Handlers Northern Ltd.
Alfred Procter House, Bute Street,
Salford, Manchester M50 1DU
Tel: 0161 745 8888
sales@airhandlers.net
www.airhandlers.net



LEADERS IN BOOSTER SETS,
PRESSURISATION UNITS AND CONTROLS

NEW

MINIPACK SERIES

A heating and chilled water
system pressurisation unit



Basic and enhanced models available.

- Maximum pressure up to 10 bar
- Temperature range from 3°C to 90°C
- Fill pressure up to 3.5 bar
- System content up to 5,000 litres
- Single or twin pump wall mounted design

NEW

AQUAMATIC AMV-FB

An energy efficient, variable speed
booster set for potable water distribution
or pressure boosting in residential,
commercial and industrial premises.



To discuss your project please call:
Head Office: **01206 215121** Manchester: **0161 226 4727**
email: sales@aquatechpressmain.co.uk
www.aquatechpressmain.co.uk



PED (Pressure Equipment Directive) Compliant
BSI Certificates CE 641230 & CE 641231



FM 33090 EMS 598248

Emax 2. Because
good things come
in small packages.



ABB introduced the Emax 2 to meet industry's calls for a low voltage circuit breaker that packs greater performance and functionality into a more compact unit. Emax 2 integrates accurate measurement, smart grid enabled communication and the option of generator protection. Its small size enabled this drilling plant to fit inside a normal sized trailer truck for road transport. www.abb.com/emax2

ABB Low Voltage
Tel. +44 (0)2476 368 500
E-mail: lv.products@gb.abb.com

Power and productivity
for a better world™



This month: Cooling backup in data centres, thermal comfort in free-running buildings, and Boswell Reid's pioneering occupant surveys

INSPECTIONS UNDER SCRUTINY

Air Conditioning Inspection Reports are designed to identify how energy savings can be made. **Jo Halpin** highlights the findings of a BRE analysis of 500 reports

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.

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 Conditioning¹.

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

➤ generally had a suitable level of professional knowledge of the systems inspected, according to the research.

The majority of ACICs surveyed related to the retail sector (45%), offices (21%) and banks (17%), with the retail outlets and bank branches air conditioned by splits, multi-splits, or variable refrigerant flow (VRF) systems. Central chillers were found mainly in the office buildings.

The most frequent recommendations in the ACIRs (see Table 1) related to the setting and operation of system controls (27%), maintenance (16%), documentation (10%) and staff training (10%). On average, there were more than nine suggestions per ACIR, but the majority were not linked to any specific measures – or savings.

The report authors say this meant no trends could be identified to link recommendations to air conditioning system types or to building use. This is in line with the findings from the European Harmonac project led by Professor Ian Knight, in which CIBSE was a partner².

The analysis also highlighted three areas not being addressed sufficiently by air conditioning inspections. These are identified in the report as:

- Sizing of equipment falling outside expected benchmarks. The spread of systems reported as being sized incorrectly – equally distributed between oversized and undersized – implies that the concept of sizing must have a wide interpretation within the industry

- 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 Trust³, 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.

Description	Frequency
Controls	27%
Maintenance	16%
Documentation	10%
Staff training	10%
Metering and monitoring	8%
Refrigerants	7%
Equipment	7%
Internal heat gains	4%
System sizing	4%
External heat gains	3%
Renewable energy	2%
Others	2%

Table 1 – Categories for classification of ACIR recommendations



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

Econoplate – comprehensive range of packaged plate heat exchangers



MADE IN THE UK

ECONOPLATE

Plate Heat Exchangers

- Various applications – hot water service, heating, process, pressure breaks and plant protection
- Compact size
- Fully assembled package
- Fast response to variable loads
- Higher temperature drop
- Low water content
- Turbulent flow and even heat distribution
- Various plate and gasket materials to suit numerous applications
- Suits many industrial and commercial applications – hotels, schools, universities, hospitals and office blocks

STOKVIS
ENERGY SYSTEMS

THE CONSULTANTS AND CONTRACTORS CHOICE.

For further information or to receive a technical guide tel: 0208 783 3050 or email: info@stokvisboilers.com

www.stokvisboilers.com

CONNECT + CONTROL



Pegler Yorkshire

If you want to maximise performance then just look at the comprehensive range of commercial valves we have on offer.

Excellent quality manufacture backed by a technical support service that's second to none.



FOR A SUPERB RANGE OF VALVES - TURN TO PEGLER YORKSHIRE

EVERY COMMERCIAL VALVE - FOR EVERY APPLICATION

FREE Phone **0800 156 0010** or email: uk.sales@pegleryorkshire.co.uk www.pegleryorkshire.co.uk

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. **CJ**

References:

- 1 DECC Study on Energy Use by Air-Conditioning BRE, 2016 www.bre.co.uk/ac_energyuse
- 2 Harmonac - *Harmonizing air conditioning inspection and audit procedures in the tertiary building sector - Energy consumption in European air conditioning systems and the air conditioning system inspection process*, 2010 <http://bit.ly/2bwjXfj>
- 2 *Air Conditioning Technology Overview*, The Carbon Trust, 2012 <http://bit.ly/2bPiXlr>



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.

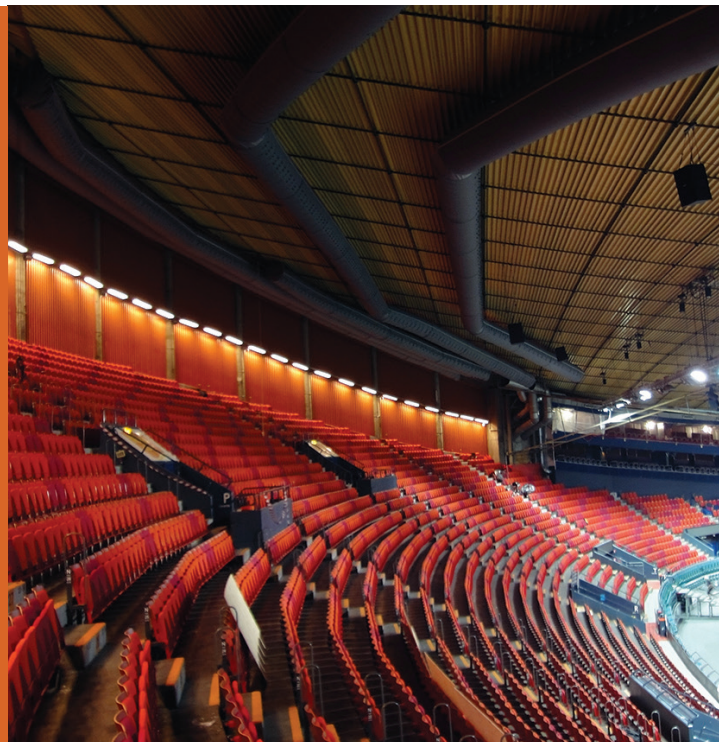
HALL OF FAME INDUCTEE

Large spaces such as halls and arenas benefit from the economies of scale available from Fabric Ducting which will be significantly cheaper than equivalent sizes of rigid ducting and will require much less secondary support infrastructure.

Our Fabric Nozzle Diffusers can throw long distances and provide specific, targeted air patterns and velocities, ideal for this type of application.

You save money and end users are more comfortable in their environment.

BE HAPPIER WITH PRIHODA >>



LEADING INNOVATIONS IN FABRIC DUCTING

3) Bespoke design, colours & printing means our fabric ducting is visually & architecturally inspirational.



for more information visit prihoda.co.uk

Luceco product installation guide:

- 1 Fit
- 2 Forget



Luceco Platinum Downlights available with gloss or matt reflectors and a range of 10 bezels. Offering zero maintenance and over 60% energy & CO₂ savings; Luceco LED luminaires are the perfect cost saving replacement versus fluorescent.

Long life LED luminaires

www.luceco.com

LUCECO
LIGHTING POSSIBILITIES



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

Always keep meticulous records and test new equipment straight away



TIMOFEEV VLADIMIR / SHUTTERSTOCK

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 an unforeseen problem. 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, but do not assume that 'normally reliable' equipment will still be reliable the next time you need it. Occasionally, it is also worth testing standby equipment beyond what the policy or the insurance company says. There are many examples of emergency generators performing perfectly for their mandatory 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

Bespoke Rooftop Packaged Units

EcoAir **Box**



SSE Arena



SSE Arena Rooftop



*A packaged solution developed
with simplicity and energy
efficiency in mind*



British manufacturing at its best

www.ecoairbox.com

info@ecoairbox.com

- *Designed to specific customer requirements*
- *Integral DX with packaged condenser section*
- *Direct driven fans with EC motor technology*
- *Digital compressors*
- *Integrated control system*
- *Compact footprint*
- *Site surveys for replacement*



IN CONTROL

Architect AHMM has used its office as a testbed for thermal strategies in a building with no cooling. AHMM's **Craig Robertson** and **Ines Idzikowski Perez**, of UCL, report on the balance between cost, comfort and productivity

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



AHMM's Morelands office in Clerkenwell, London

densely occupied open-plan studio space with generous breakout space and socialising areas.

The UK legislative context forces us to think about buildings in a particular way: Part L can encourage systems designed for fixed internal comfort thresholds; CIBSE overheating criteria begins to suggest an adaptive view of comfort but has a fixed upper threshold; BCO guidance can become the default recipe for office design rather than a set of principles.

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. Ventilation strategies must also be mindful of air quality and noise pollution in city centres.

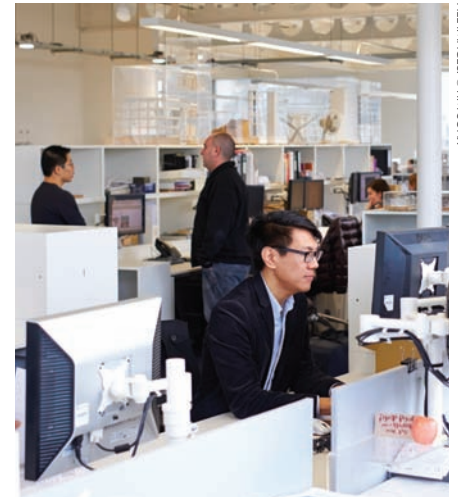
We have been developing an architectural idea of lean buildings – efficient structures, minimum applied finishes, ease of functional adaptation and low waste during tenancy changes. Adaptive standards are more appropriate in this kind of building.

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.



ALL IMAGES: ©TIM SOAR

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,^{1,2} and have established quantitative relationships between the indoor temperature and the rate of productivity loss.^{3,4}

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

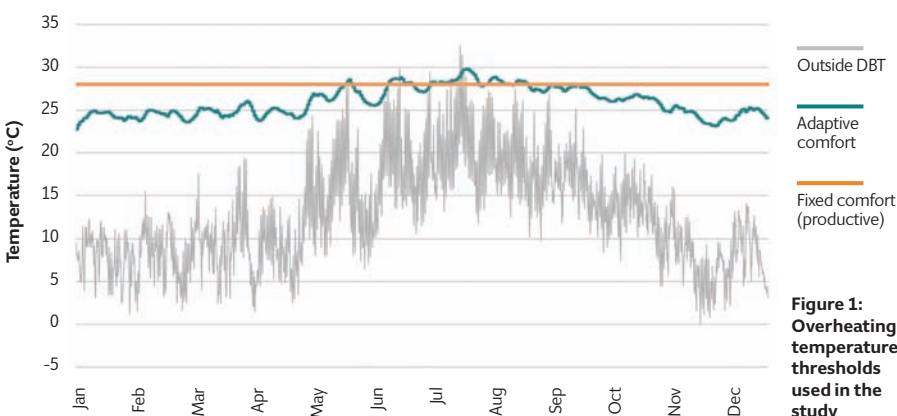


Figure 1: Overheating temperature thresholds used in the study

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

Free-running mode

Free running is a mode of operation of a building rather than a specific building type. A building is free running when it is not consuming energy for heating or cooling. So, typically, non-air conditioned UK buildings are in free-running mode in mid-seasons and summer, but not in winter.

Because a free-running building has no mechanical cooling, CIBSE’s AM10 suggests that to achieve comfortable conditions in such

a building, the occupancy rate should be 10m² per one person, and total internal heat gains should not be more than 40W/m².

Because free-running buildings are typically – but not exclusively – user operated, there is potential for more relaxed comfort standards to be applied. An adaptive comfort threshold, along with well-considered operational management could allow for occupant density and internal gains to exceed AM10 guidelines.

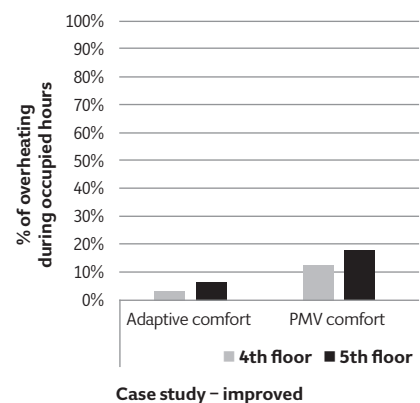
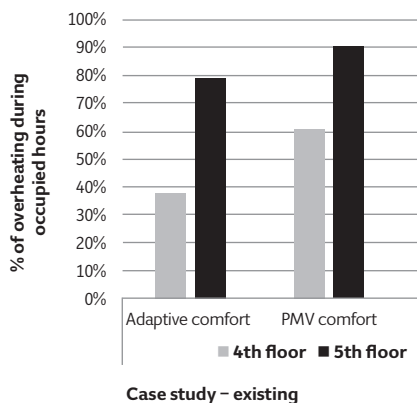


Figure 2: Overheating during occupied hours for different temperature thresholds



Morelands in Clerkenwell is near the centre of the London urban heat island

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.
- 2 Wyon, D P & Wargocki, P, 2013. How indoor environment affects performance. *ASHRAE Journal*, 55(3), pp.46-52.
- 3 Jensen, K L, Toftum, J & Friis-Hansen, P, 2009. A Bayesian network approach to the evaluation of building design and its consequences for employee performance and operational costs. *Building and Environment*, 44(3), pp.456-462.
- 4 Seppanen, O & Fisk, W, 2006. Some quantitative relations between indoor environmental quality and work performance or health. *HVAC&R Research*, 12(4), pp.957-973.
- 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 study⁴, 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 CIBSE⁵ based on the mean outdoor temperature.

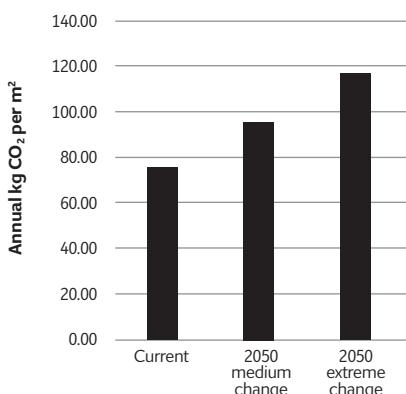


Figure 3: Carbon emissions from air conditioning

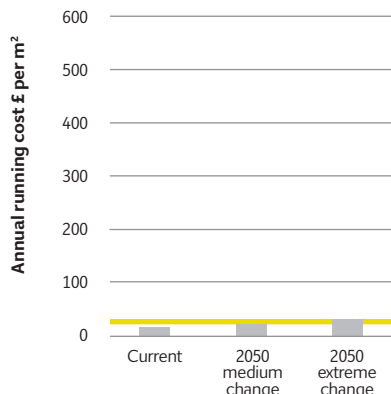


Figure 4: Running costs of air conditioning

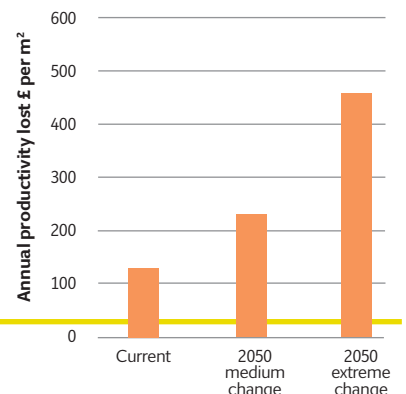


Figure 5: Cost of productivity lost due to overheating

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)



Digital Engineering Series

The Knowledge to Navigate PQQs using PAS 91:2013

The Pre-Qualification Questionnaire (PQQ) process is there to make bidding for work simpler and more affordable.

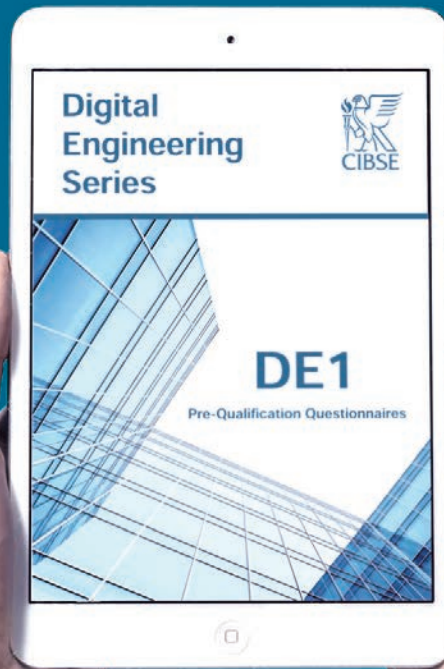
CIBSE is offering a free template to make the process simpler for those who generate, complete or review PQQs using PAS 91:2013.

www.cibse.org/DES

Download
a FREE PQQ
template

Introducing
CIBSE's
new Digital
Engineering
Series

£50
(50% discount
for CIBSE
members)



DE1 Pre-Qualification Questionnaire is the first in a new Digital Engineering Series to assist the full built environment supply chain in tackling the practical challenges, specifically of the BIM processes, of digital engineering more widely.

Purchase a
copy of DE1
online now

Coming soon:

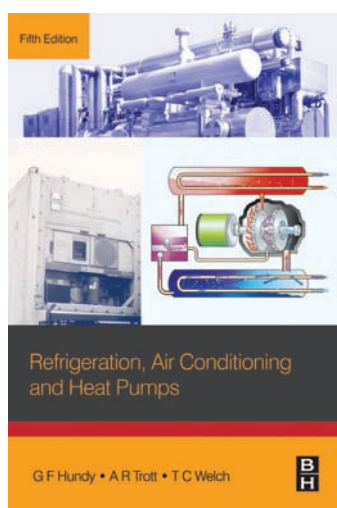
- **September** DE2 Employer's Information Requirements (EIR)
- **October** DE3 BIM Execution Plan (BEP)
- **November** DE4 Common Data Environment (CDE)

www.cibse.org/DES



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**



Book review: *Refrigeration, air conditioning and heat pumps*, by G F Hundy, A E Trott and T C Welch

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

Large systems such as this air-cooled glycol chiller need to be assembled on site (Business Edge)

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

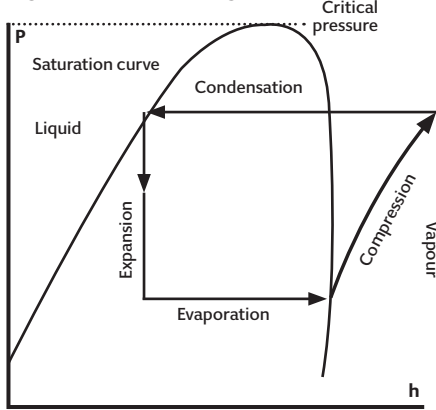
illustrations, including cut-away images and diagrams showing the operating principles of components – and, in many cases, the performance curves and calculations for components such as compressors, evaporators, condensers and control valves.

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. ➤

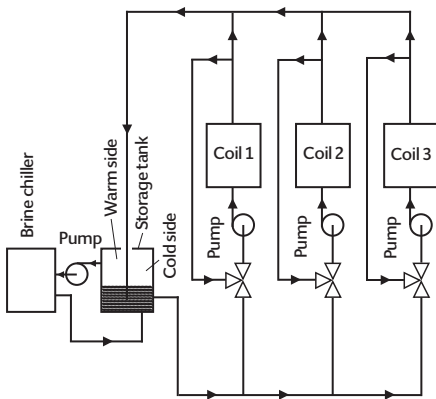


Figure 1: Mollier diagram



Pressure-enthalpy, P-h diagram showing the vapour compression cycle

Figure 2: Food store circuit



Brine circuit for rooms at different temperatures in a food store

➤ 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

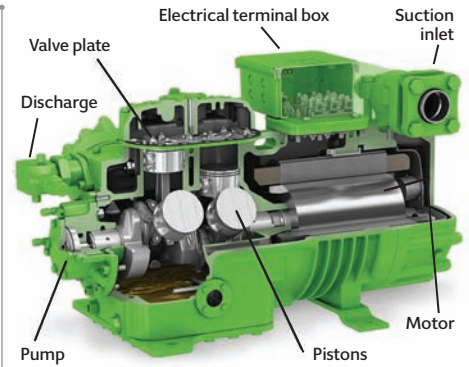
Because refrigeration is a key component in the catering industry, the book details the various technologies used in the food chain, from chilling or freezing food – including the processes appropriate for individual food types – storage and transport of the cold product, to display at the point of sale.

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.



Cutaway of a small commercial six-cylinder compressor (Bitzer)

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



HVAC PROBLEMS?

Whether your project involves a new build, replacement or refurbishment of existing HVAC equipment, whether you're looking for improved performance, greater reliability or better energy efficiency (or all three), whether you have a specific problem such as old, worn out, inefficient equipment or you are constrained by space...

...Weatherite will have a solution

That's the benefit of over 43 years' HVAC experience: In-house expertise in design, development, manufacture, installation (if required), commissioning and support services means that Weatherite will have the right solution for you.

Call 0121 665 2266 or email: sales@weatheritegroup.com



www.weatheritegroup.com

Part of the Weatherite Group of Companies

ReCooler[®] HP

No Chiller, No Condenser, No Boiler, No Pipework

Our **ReCooler[®] HP** is a DX heat pump unit that is optimised for indoor air temperature (Summer and Winter) located within our exceptional **eQ Air Handling Unit** range. The ReCooler gives you a compact design that delivers an easy, low cost installation.

- **Eco Design** 2016 & 2018 compliant
- Simple "plug-and-play" installation
- Integrated heating and cooling recovery
- In Heat recovery the unit delivers a **COP** in excess of **10**
- In Cooling recovery the unit delivers a **SEER** in excess of **7**
- Piped, charged & tested before dispatch
- No separate condenser required
- Easily accessible for servicing
- Lower energy consumption

ENVIRONMENT
ECONOMICAL
EXPERTISE

ReCooler[®] HP integrated within our eQ range of Air Handling units offers total energy recovery with integrated DX cooling and heating. With our SEMCO sorption rotary heat exchanger which offers 'Best in Class' heating and cooling recovery, and with the addition of heat pump technology, we can enhance your overall energy efficiency - Fläkt Woods, your perfect partner in ventilation and energy saving!

www.flaktwoods.co.uk



QUESTION TIME

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**

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



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.

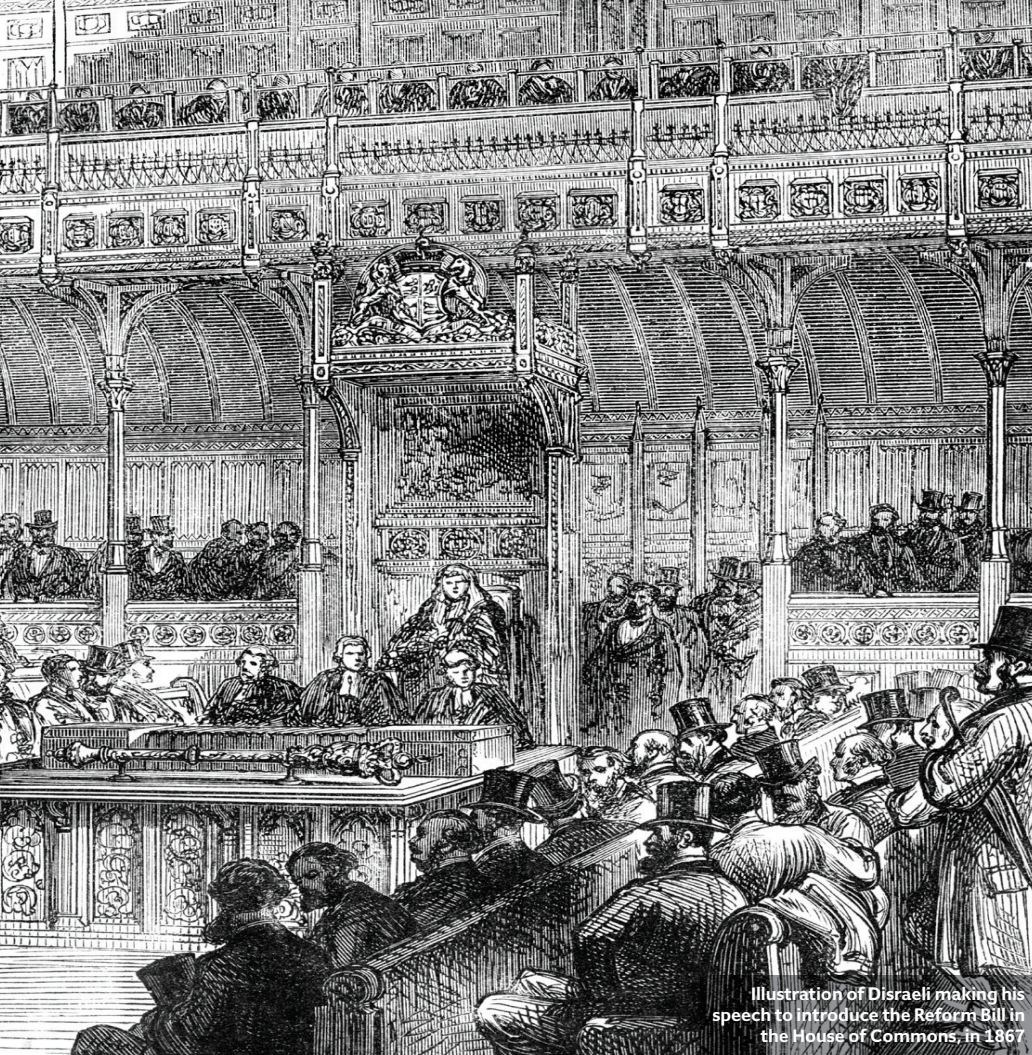


Illustration of Disraeli making his speech to introduce the Reform Bill in the House of Commons, in 1867

By continually critiquing the internal conditions, MPs and peers became active agents in evaluating Reid’s system

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 65F, 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 5F 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

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



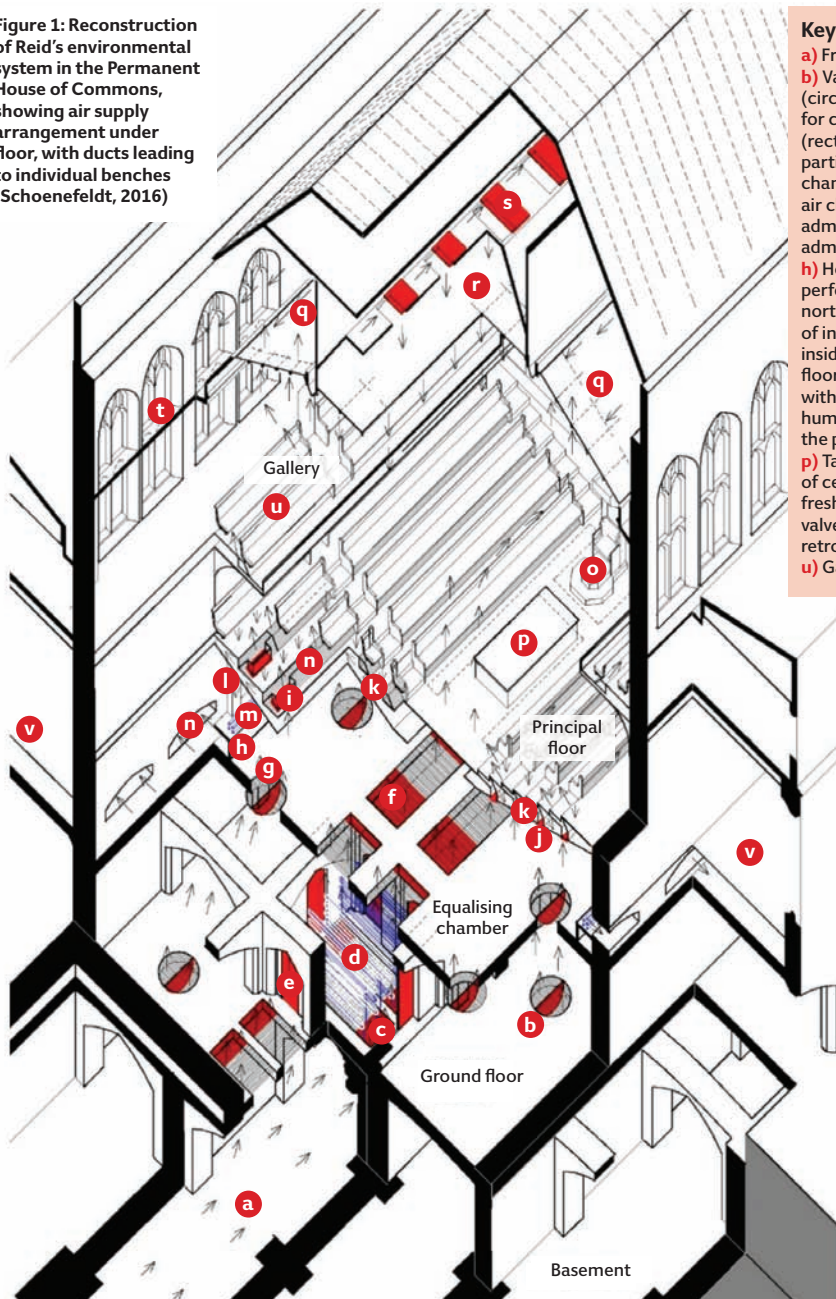
Illustration of the House of Commons in 1900

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.¹ 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

Figure 1: Reconstruction of Reid's environmental system in the Permanent House of Commons, showing air supply arrangement under floor, with ducts leading to individual benches (Schoenefeldt, 2016)



Key
a) Fresh air passage linking inlets shafts to central air chamber;
b) Valves for conveying air from basement into cool air chamber (circular valves with shutters, shown in open position); **c)** Valves for conveying air from basement to central heating chamber (rectangular valves with adjustable curtains below grating, shown partially opened); **d)** Pipes of hot water apparatus in heating chamber; **e)** Vertical door valves for conveying hot air into cool air chamber; **f)** Rectangular curtain valve through which hot air admitted into equalising chamber; **g)** Circular shutter valves to admit unheated air from cool air chamber into equalising chamber; **h)** Horizontal duct in which vitiated air was extracted through perforated floor collected before being exhausted via boiler in north-west turrets of the Central Tower; **i)** Sliding valves for supply of individual benches; **j)** Sliding valves for supply through treads inside the gangways; **k)** Vitiated air chamber under perforated iron floor (extract); **l)** Vertical ducts connecting vitiated air chamber with horizontal ducts; **m)** Steam and hot water pipes (heating and humidification); **n)** Valves conveying air to fresh air chamber under the perforated floor of the Division Lobbies; **o)** Speaker's chair; **p)** Table; **q)** Vitiated air chamber above sloping side panels, extract of ceiling system; **r)** Fresh air chamber used to supply tempered fresh air through central ceiling panels (ceiling system); **s)** Sliding valves for regulating air supply to ceiling; **t)** Line of acoustic ceiling retrofitted in 1851, covering half of Barry's original window; **u)** Gallery with air supply through floor; **v)** Division Lobbies

► thermometers are too high or too low, I give directions accordingly.'

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.

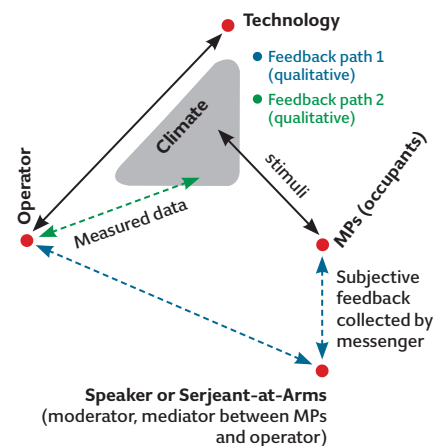
In the Temporary House of Lords, he investigated how far user satisfaction could be increased by creating microclimates in different areas of the chamber, each responding to local differences in crowding. Responses from the Lords, collected between 1838 and 1846, show that this new approach did not succeed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

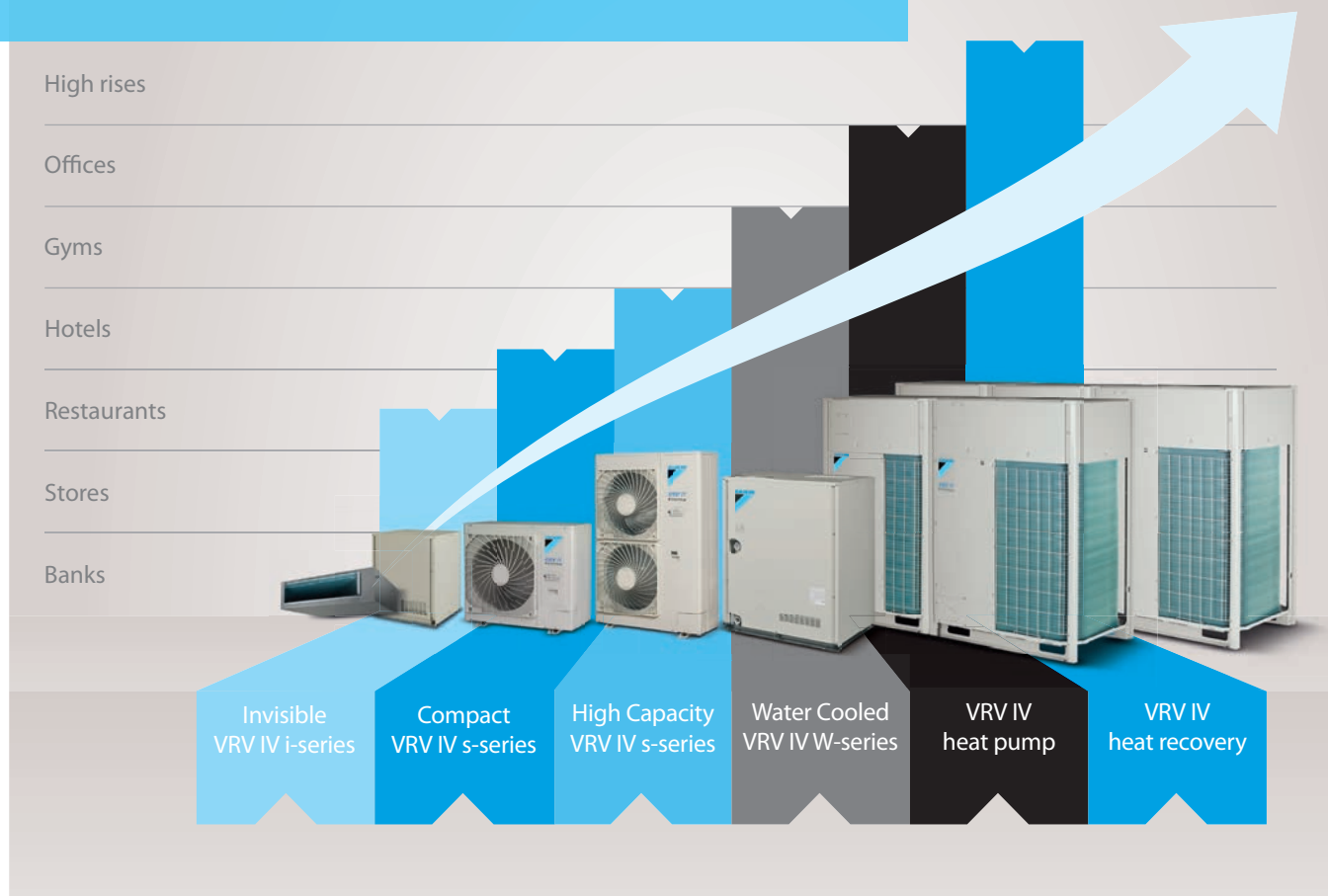
Not unlike a modern BMS, attendants followed a 'programme' with a set range of climatic parameters and ventilation rates; these could be 'overridden' based on MPs' self-reported experience

Conditions feedback



System by which measured data and subjective feedback was communicated and processed as part of the day-to-day management (Schoenefeldt, 2016)²

Design Versatility That's off the charts



VRV IV systems deliver design versatility and building performance that's off the scale.

From invisible and compact solutions for discreet installation, to large scale heat recovery and water cooled solutions that are powerful enough for buildings of over 5000m² floor area, Daikin has the most efficient solution to all your design challenges.

A modular VRV system can be designed to match the precise requirements of every building, with precise zone control of unlimited indoor units and piping lengths of up to 1,000m overall.

So now you can design a fully integrated system for heating and cooling, hot water, air curtains and fresh air handling, with Variable Refrigerant Temperature modes and intelligent controls to help you achieve new heights of seasonal efficiency.

[Find our more at daikin.co.uk/vrv](http://daikin.co.uk/vrv)

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.

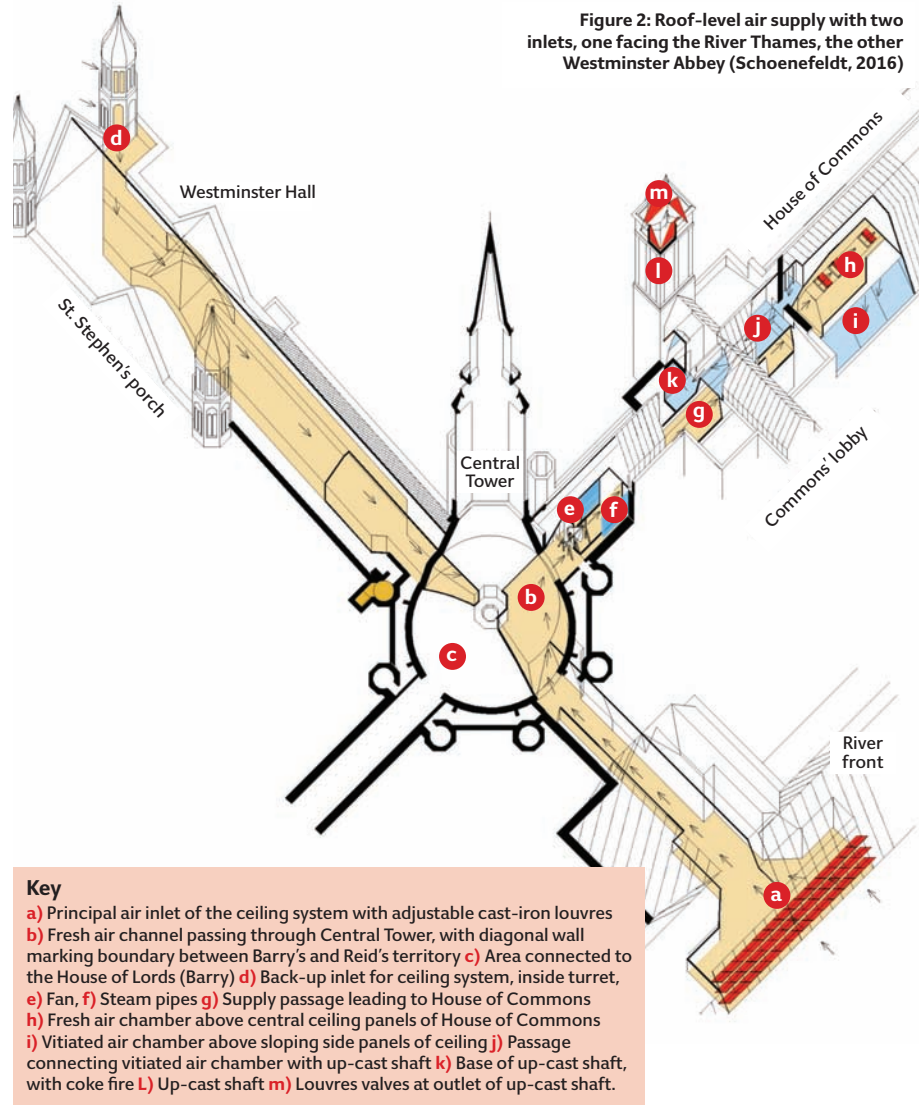
Not unlike a modern building management system (BMS), attendants followed a 'programme' with a set range of climatic parameters and ventilation rates; however, these could be 'overridden' based on MPs' self-reported experience. Feedback on the conditions inside the chamber was transmitted to the attendants 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. CJ

References:

1 Henrik Schoenefeldt, 'The Temporary Houses of Parliament and David Boswell Reid's architecture of experimentation', *Architectural History*, 57 (2014), pp175-215

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

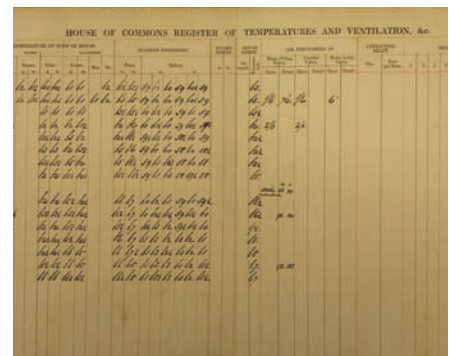
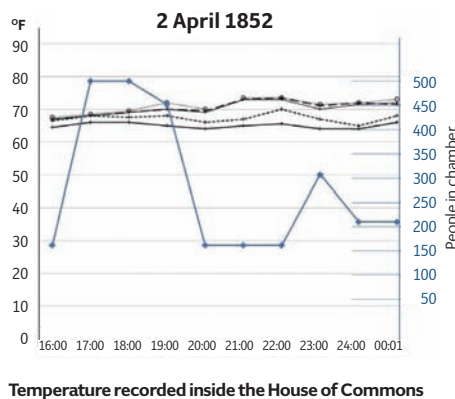


Key

- 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.

2 A detailed anatomical reconstruction of Reid's original ventilation system is provided in: Henrik Schoenefeldt, 'The Lost (First) Chamber of the House of Commons', *AA Files*, 72 (2016) pp161-173; Henrik Schoenefeldt, 'Reid's Short-lived ventilation system for the Permanent House of Commons', in *Studies in the History of Construction* (Cambridge: CHS, 2015), pp167-82. <http://bit.ly/2bhP6jK>

DR HENRIK SCHOENEFELDT is a member of the CIBSE Heritage Group and an Arts and Humanities Research Council (AHRC) leadership fellow



Temperature recorded inside the House of Commons

Logbook page, 8 April 1853 (Parliamentary archives)



THE MOST COMPACT

CADB-HE/CADT-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

S&P HEAT RECOVERY UNITS FOR ALL APPLICATIONS
LOW CONSUMPTION WITH HIGH COMFORT LEVELS



www.solerpalau.co.uk

sales.uk@solerpalau.com

T: 0845 4700074

F: 0845 000075

Replace the Fan... ...Not the System

- ErP is here
- Fit only 2016 compliant fans
- Helps reduce energy costs
- Proven reliability
- Compact, quiet, powerful

Maintaining efficient ventilation is key to quality indoor air but why go to the expense of total replacement of your fan coils, VAV, AHU's and fan assisted chilled beams.

Upgrade with EC Fan technology that is quick and simple to install.

Contact **Airflow**, we have over 60 years of air movement expertise.



Call: 01494 560800

Visit: airflow.com



MyPortal

Your unfair advantage.

BIM Centre



Create 'as-built' pipe systems quickly and accurately with our unique Revit content packages.

Technical Tools



Great tools to help you get the job done faster and with assured accuracy.

myportal.wavin.co.uk

eLearning



Invaluable, accredited courses, written by Wavin experts to add to your CPD, or just increase your knowledge.

Forum



Join the conversation on a whole world of topics and issues to share your view and hear what others think.

In one place and available 24/7, MyPortal gives you free access to exclusive content, with no limit to how much you access, learn, watch, download, use and share. It's a hub of rich content that can give you a valuable advantage, whatever your role. It's our way of giving back to people in our industry and sharing the knowledge we hold as the UK's leading manufacturer of plumbing, rainwater and drainage systems.

Come in and look round at myportal.wavin.co.uk



CONNECT TO BETTER



Professional development

The CIBSE Journal CPD Programme

Members of the Chartered Institution of Building Services Engineers (CIBSE) and other professional bodies are required to maintain their professional competence throughout their careers.

Continuing professional development (CPD) means the systematic maintenance, improvement and broadening of your knowledge and skills, and is therefore a long-term commitment to enhancing your competence. CPD is a requirement of both CIBSE and the Register of the Engineering Council (UK).

CIBSE Journal is pleased to offer this module in its CPD programme. The programme is free and can be used by any reader. This module will help you to meet CIBSE's requirement for CPD. Equally, it will assist members of other institutions, who should record CPD activities in accordance with their institution's guidance.

Simply study the module and complete the final page questionnaire, following the submission instructions. Modules will be available online at www.cibsejournal.com/cpd while the information they contain remains current.

You can also complete the questionnaire online, and receive your results by return email.

Propane as a refrigerant for use in chillers for air conditioning applications

This CPD explores the increasing use of propane for air conditioning applications

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 (R290) 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,



Propane molecule

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.¹ 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 barbecues 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 EN378 Part 1² 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/flammability 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 (2L); 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

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

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

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



Figure 1: A 500kW air-cooled propane chiller (Source: Cool-Therm)

Refrigerant	Propane	R134a		HFO-1234ze	
Compressor type	Screw	Screw	'Turbocor'	Screw	'Turbocor'
Cooling capacity (kW)	417	417	417	417	417
Power including fans (kW)	152	147	121	121	118
Energy class	C	C	A	A	A
Energy efficiency ratio (EER)	2.74	2.84	3.43	3.27	3.53
Seasonal EER (SEER)	4.6	4.57	5.09	5.15	5.26
Approximate modulation	20-100%	20-100%	0-100%	20-100%	0-100%
Refrigerant charge (kg)	44	82	79	159	76
Refrigerant GWP	3	1,370	1,370	6	6
Length (m)	4.5	4.51	4.51	4.51	4.51
Width (m)	2.25	2.25	2.25	2.25	2.25
Height (m)	2.54	2.54	2.53	2.54	2.54
Weight (kg)	4,498	4,583	3,026	4,629	3,241
Indicative relative capital cost	100%	72%	98%	93%	127%

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

release of a flammable gas. Wherever possible, the discharge port on the valve must be directed to a safe place, away from any source of ignition – preferably in an upward direction, to prevent pooling of propane at low level.

For transport to site, the framework of propane chillers should completely enclose all the refrigeration system pipework and components that contain propane. This is to avoid accidental damage and the release of the flammable gas during transportation and handling.

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/EU⁴ 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 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 regulations⁵ 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 extant 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 when considering low GWP cooling plant for commercial buildings. Apart from flammability considerations, propane chillers are not too dissimilar from those that have been used for many years in the building services industry. They have similar designs, dimensions, weight and

efficiency, and can be equipped with inverter-controlled capacity to operate effectively across varying loads. A propane plant is around 39% more expensive than a basic screw compressor chiller operating on R134a. However, when other low-GWP, high-efficiency chillers are compared (as in Table 2), the cost difference is minimal – just 7.5% higher than a screw compressor chiller working with HFO-1234ze refrigerant, and 27% less than a 'Turbocor' compressor working with HFO-1234ze.⁶

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.

© Ken Strong and Tim Dwyer, 2016.

Further reading:

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

Guide to flammable refrigerants, BRA, <http://bit.ly/29O6f6R>

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:

- 1 Pandavly, P. et al, *Ecofriendly Refrigerants*, Applied Mechanics and Materials Vol. 612 (2014), pp 181-185.
- 2 BS EN 378-1:2008, *Refrigerating systems and heat pumps - Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria (+A2:2012)* (incorporating corrigendum December 2008).
- 3 ISO 817:2014, *Refrigerants - Designation and safety classification*.
- 4 Directive 2014/68/EU on the harmonisation of the laws of the member states relating to the making available on the market of pressure equipment, May 2014.
- 5 See www.gov.uk/guidance/f-gas-in-refrigeration-air-conditioning-and-fire-protection-systems for detailed information.
- 6 Data supplied by Cool-Therm.

Turn over page to complete module ➤

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

Are you a member of:

CIBSE

If so, please state your membership number

(if available)

Other institution

(please state)

To help us develop future CPD modules, please indicate your primary job activity:

Building services engineer

Mechanical engineer

Electrical engineer

Commissioning engineer

Energy manager

Facilities manager

Other (please give details)

If you do NOT want to receive information about Cool-Therm, the sponsor of this CPD module, please tick here:

By entering your details above, you agree that CIBSE may contact you from time to time with information about CPD and other training or professional development programmes, and about membership of CIBSE, if you are not currently a member.

Please go to www.cibsejournal.com/cpd to complete this questionnaire online. You will receive notification by email of successful completion, which can then be used to validate your CPD records in accordance with your institution's guidance.

Alternatively, you can fill in this page and post it to:

N Hurley, CIBSE, 222 Balham High Road, London, SW12 9BS

If you control energy **efficiently and precisely**, you create the optimum working environment

SAUTER creates the best working environments

Exceptional architecture meets good environmental practice; exceptional energy efficiency meets good service.

We supply products, systems and services for integrated Building and Energy Management Systems, which ensures your investment is long term and which helps you reduce your operating costs. If you wish, we will work with you from your initial idea to the day-to-day running of your building.

For further information contact:
Gary Williams on 0203 486 2045
or by email gary.williams@uk.sauter-bc.com

**Systems
Components
Services
Facility Management**



Healthcare Estates
Conference. Exhibition. Dinner. Awards.
4-5 October 2016 Manchester Central



Register Now

Transforming the estate through collaboration. Integrate efficient patient-centred environments by collaborating with the right people, find inspiration and foster aspirational attitudes.

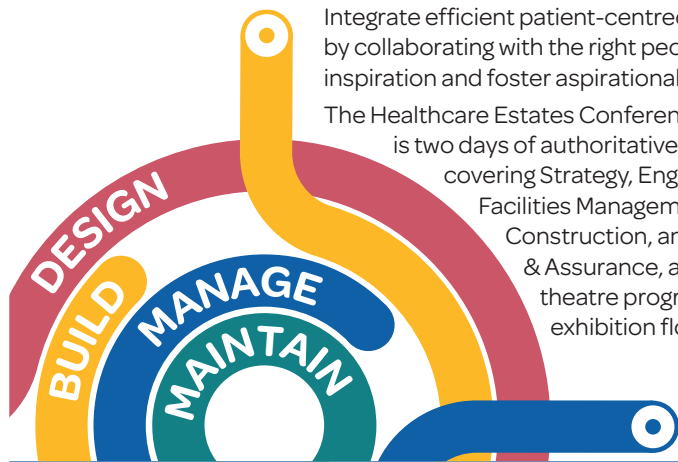
The Healthcare Estates Conference & Exhibition is two days of authoritative content, covering Strategy, Engineering and Facilities Management, Design & Construction, and Governance & Assurance, as well as theatre programmes on the exhibition floor.

HOT TOPICS

'The £22bn challenge; the view from Department of Health' *David Williams, Director General of Finance, Department of Health* will give the view from the top; of the £22bn challenge, the role of the NHS Estates and Facilities Community, and achieving £1bn in efficiency savings. All NHS staff and partners qualify for VIP discounts and on-site benefits.



#HCEstates16



www.healthcare-estates.com

Event Partner 	Main Event Sponsor 	Principal Media Partner 	VIP Sponsor 						

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 NO_x 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'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



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.

Pump members have been deployed to help with: cooling; delivering hot water; ensuring that sufficient water is available; supporting the sewage and drainage demands; irrigation; and offering their assurance through the fire-fighting sets.

Grundfos's presence is more visible at the central feature of the Athletes' Village, where 134 SP submersible pumps operate in unison to produce the spectacle of the water-dance fountain. The company is delighted that it has maintained its personal track record of supporting all the major sporting events in recent years.

● Call 01525 850 000, email grundfosuk@grundfos.com or visit www.grundfos.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 finer 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



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



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.scotland@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'.

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

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 are approved for use in hospitals.

● Call 0845 402 3434
or visit www.myson.co.uk

Rounded edges to minimise injuries

Surface remains under 43°C to eliminate burns

Easy access for cleaning, maintenance and decorating

Compliant for NHS applications



Imax Xtra EI is top of the class on NO_x emissions

Ideal Commercial Boilers is committed to ensuring that its condensing boilers outperform current regulations in terms of output, efficiency and energy use.

The latest addition to its floor-standing condensing boiler range – the Imax Xtra EL – is the only UK boiler to have been awarded a Class 6 NO_x rating from the European Standard EN 483: 2000 relating to gas-fired central heating boilers.

Several have been installed in the educational, religious and manufacturing market sectors.

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



Kingspan KoolDuct streamlines space

A manufacturing site near Belfast has been upgraded as part of a £35m investment programme. The work included the installation of Spiralite flat oval ductwork fabricated from Kingspan KoolDuct Panels, which provided a lightweight, fast-track HVAC solution for the project.

Kingspan KoolDuct Panels comprise a non-fibrous rigid thermoset modified resin insulation core. The panels can achieve thermal conductivities as low as 0.022 W/m·K and have been assigned a BRE Green Guide Summary rating of A.

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

V850 gate valves open up a plethora of opportunities

Doncaster-based Pegler Yorkshire has introduced the V850 ductile iron gate valve to its commercial valve offering, adding a solution for potable water applications.

Gate valves – primarily used to allow the flow of liquids – ensure low friction loss, and offer a high-flow path when in the fully opened position.

The new V850 is characterised as having a non-rising stem, which supports ease of operation in confined spaces. Its design incorporates a stainless steel stem that offers resistance to corrosion.

● Call 01302 560 560, email brochures@pegler-yorkshire.co.uk
or visit www.pegler-yorkshire.co.uk



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 the 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.

● Visit www.aircon.panasonic.eu

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 Silavent 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



Trend triumphs at the Business Matters Business Awards 2016

Trend Control Systems, international manufacturer and supplier of building energy management systems (BEMS), is celebrating its success at the Business Matters Business Awards 2016.

The Sussex-based company fought off stiff competition to walk away with the Manufacturing and Construction Award, which recognises the investment it has made in this area of its business, as well as its high operating standards.

As one of the area's largest employers, Trend has a well-established and successful apprenticeship programme, and believes building control technology offers a bright future for those wishing to work at the cutting edge of the green agenda.

Accepting the award, Alan Carter, Trend's research and development manager, said: 'We are immensely proud of our long association with Sussex and believe that the region offers all the ingredients for business success. I am thrilled that Trend's manufacturing and business excellence has been recognised in this way.'

● Call 01403 211 888
or email marketing@trendcontrols.com



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



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 plugging leaks in clay pipes, caulking tunnel segment joints and installing fixings in water structures requiring immediate use

● Call 01403 210 204



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



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-IO-24 I/O module.

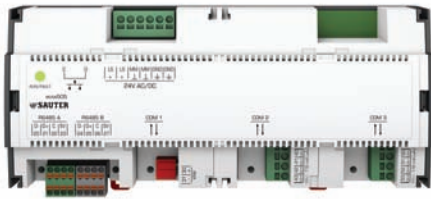
The new I/O module can take inputs from standard field devices and transmit them over BACnet or Modbus protocols, offering a cost-effective solution for expanding I/O on an existing controller.

The SC-IO-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

PRODUCTS & SERVICES

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



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 convactor

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

DIRECTORY Your guide to building services suppliers

Telephone: 020 7880 7633 Email: greg.lee@redactive.co.uk

Air Conditioning

CLIVET®

For total solutions in air-conditioning

E: info@clivet-uk.co.uk
W: www.clivet.com
T: 01489 572238
W: www.versatemp.co.uk

Air Conditioning

PAYING TOO MUCH FOR DAIKIN PARTS?

Space Air have been supplying genuine Daikin parts since 1980.

Call now for the best prices and availability!

0333 0069 754

www.spaceair.co.uk

Air Handling

Manufacturer of high quality bespoke AHU's. Specialists in refurbishment and site assembly projects.

Rapid delivery service available.

Aircraft Air Handling Ltd
Unit 20, Moorfield Ind Est,
Cotes Heath, Stafford, ST21 6QY
Tel: 01782 791545 Fax: 01782 791283
Email: info@aircraftairhandling.com Web: www.aircraftairhandling.com

Energy Efficiency

GROENHOLLAND

Ground Source Heat Pump Installations

Meeting Renewables Targets

Tel: 02392 450889
Fax: 02392 471319
www.groenholland.co.uk

Certificate Number MCS 1201 Heat Pumps

Ventilation and Air Conditioning

Grilles & Diffusers **Heat Recovery Units** Menerga
Chillers & Heat Pumps
VRF & DX Splits Radiant Heating
Fan Coil Units **Fans** Air Curtains
Fire & Smoke Dampers **Air Handling Units**

Trust systemair. Email: info@systemair.co.uk
One Partner - a million possibilities Web: www.systemair.co.uk
Tel: 0121 322 0200



ESTATES DEPARTMENT

Operational Maintenance Manager

Vacancy Ref: LSX0002-1

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

For further details and to apply please visit <https://jobs.brunel.ac.uk/WRL/>



COMMITTED TO EQUAL OPPORTUNITIES AND REPRESENTING THE DIVERSITY OF THE COMMUNITY WE SERVE



<http://www.brunel.ac.uk>



Senior Mechanical and Electrical Opportunities London, £40-52k + benefits

We are an independent specialist MEP and environmental services engineering and design consultancy employing over 200 staff across our London headquarters, regional offices in Kent and Birmingham, and internationally in Dubai and Abu Dhabi.

We are currently seeking exceptional Senior Mechanical and Electrical Engineers to join our London teams as part of our growth plans. Working with signature architects, you will deliver projects ensuring that the company quality standards are being achieved, preparing design calculations, specifications and drawings, ensuring that we deliver world class projects across a wide range of sectors.

You will have proven experience of commercial (new build, refurbishments and fit out), residential and mixed use developments and must possess an in depth knowledge of Building Services Engineering Systems. We employ talented, motivated individuals who are passionate about working on interesting projects.

In return we offer a competitive salary, 24 days holiday (increasing to a maximum of 28 days per annum), performance related bonus, pension scheme, private healthcare, life assurance, travel insurance, dental, Employee Assistance Programme, childcare vouchers, and more.

Please forward a copy of your CV, together with your salary/package expectations to recruitment@chapmanbdsp.com

ChapmanBDSP is an Equal Opportunities Employer and welcomes applications from all communities.

conrad consulting
technical recruitment specialists

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

Associate Mechanical Engineer Southwark

£65k + Package

Associate Mechanical Engineer required to lead projects within the commercial, residential & hotel sector. This building services consultancy is rapidly expanding due to a number of large project wins and are looking for candidates to become a Director within 12-24 months.

Associate Director - Electrical Covent Garden, London

£65,000 + Package

Up for a challenge and want to help build something a bit special? I'm looking for an AD with an electrical bias to assist in the development and expansion of a new, unique building services consultancy in London. Great opportunity to work with engineers and architects who are passionate about sustainability within the built environment.

Sustainability Project Manager (Client Side) Docklands, London

£45,000 + Benefits

Well-publicised developer requires a sustainability project manager. You will be tasked with guiding project delivery of the sustainability strategy on some of the City's most iconic projects, working on EMS reviews of pre-tenders and environmental submissions from consultants. The main aim will be to maximise BREEAM, LEED and Code for Sustainable Homes ratings.

Senior Mechanical Design Engineer Cambridgeshire

Up to £55,000 + Benefits

Outstanding opportunity within an MEP Design Consultancy for a technically capable Engineer. Leading projects that include hospitals, universities and manufacturing plants you will demonstrate your aptitude for client liaison.

Find all jobs at conradconsulting.co.uk

George@conradconsulting.co.uk
London 0203 1595 387

b-a-r beebey anderson recruitment

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

Mechanical Design Engineer

£60k - £65k + benefits, London

Our client is a global multi-disciplined design consultancy with offices in over 20 countries that are well known for their environmentally friendly sustainable designs. They are looking for a mechanical design engineer to join their mission critical team to work on data centre projects. You will be working with the worlds most renowned brands in the social media sector, producing designs, supervising on site, and be responsible for overall delivery. In return you will receive training, a competitive salary and future promotion. Ref: 3722

Electrical Associate

to £80k + benefits, London City

Operating in various sectors, but specialising in mission critical projects and corporate fit out, my client who was established in the 80's is offering an associate electrical engineer the chance to progress into a partner. Supporting the Directors, you will look after key clients, win business, and manage an M&E team. Exceptional package offered to the right person. Ref: 3766

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: 3752

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

Senior Electrical Engineer

£30k - £45k + bens, Bristol

If you are looking to progress and develop your career, we have a role for an enthusiastic engineer looking to establish themselves with one of the UK's leading consultancies. With high profile projects spanning across the higher education, pharmaceutical, arts & culture, commercial and health care sectors you will gain exposure to very high quality projects working alongside some of the best engineering minds in the country. There will be investment in your personal development including Chartered sponsorship and both technical and professional training. This is a great opportunity to become part of a forward thinking and multi award winning company. Ref: 3715

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. 3-6 Month contract. Ref: 3729

Thinking of your future

www.b-a-r.com



Training

Providing training solutions for individuals and companies

CIBSE Training run hundreds of CPD courses annually for building services professionals and energy assessors. These are delivered online, at our training venues or in-house.

- Qualified and experienced trainers
- Latest industry knowledge
- Over 200 courses a year
- Competitive rates

Take your next steps to professional success

CPD Courses

Online Learning

Corporate Solutions

Energy Assessor Training

www.cibse.org/training

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

Lighting is both an art and a science; it's as much about creative design as it is about lux levels

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 Bellow. 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 Building Regulations: Part L

6 October, Manchester

Emergency lighting to comply with fire safety

7 October, London

Lighting design: principles and application

12 October, London

Electrical distribution design

13 October, London

Energy strategy reports

18 October, London

Mechanical services explained

19-21 October, Manchester

Building drainage explained

20 October, London

Electrical services explained

25-27 October, London

Building services explained

26-28 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

4-5 October, Sheffield

Heat networks

5-6 October, Newcastle

CIBSE GROUPS, REGIONS AND SOCIETIES

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

SLL & CIBSE South West: LG6

The exterior environment
8 September, Bristol
A talk by Alan Tulla, 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, Chalfont 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 Mark 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

26 September, Milton Keynes
Seminar by Varano, covering: 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
Focusing on applications for the Associate and Member grades, and registration with the Engineering Council at the incorporated and chartered engineer levels.

West Midlands: Technical seminar on radiant heating panels

28 September, Birmingham

Introduction to SoPHE plus hygienic drainage for food processing applications

28 September, Oxford

Introduction to the Society of Public Health Engineers, followed by a presentation by ACO Building Drainage.

SFE technical meeting and AGM

29 September, London

Glass - emerging from the shadows: a talk by Tim Macfarlane, of Glass Light and Special Structures.

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 - 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 Alexa 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, seed-cake 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



Performance. Inspiration. Aspiration.

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.

The confirmed programme features over 40 respected industry speakers presenting specialist content addressing the following key themes:

ACHIEVING PERFORMANCE IN USE

AIR QUALITY: IMPACT ON HEALTH & WELLBEING

COLLABORATION FOR BETTER PERFORMANCE

DIGITAL ENGINEERING & BUILDING SERVICES

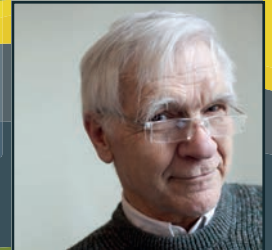
INNOVATION IN BUILDINGS

OUTLOOK FOR BUILDING PERFORMANCE

REFURB + RETROFIT



KEYNOTE
Patrick Bellew
Principal
Atelier Ten



KEYNOTE
Max Fordham
Founder
Max Fordham

To register or view the full programme and speaker list visit:

www.cibse.org/conference

17-18 November
2016
QEII Centre
Westminster, London
@CIBSE #CIBSEconf



Supporters:



Drinks reception sponsor:

CMR

in complete control

CMR Controls manufactures low air pressure and air volume measurement sensors and control systems for standard air conditioning, clean rooms, sterile laboratories, containment facilities, and fume cupboard extract systems.

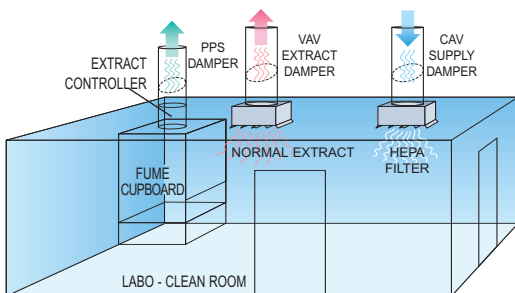


DPM PRESSURE SENSOR

Panel Mount Pressure or Velocity Transducers with remote alarms, analogue and digital interfaces. Traceable calibration certificates supplied as standard.

AIR MANAGEMENT SYSTEM

A complete turn-key system to control room pressure to +/-1Pa. Fume cupboard face velocity to 0.5m/s at high speed and provide constant air changes into the labo - clean room.



DPC CONTROLLER

Fast and accurate controls to drive high speed dampers or invertors. Full PID stand alone controls with BMS interface.

CAV AND VAV DAMPERS

Accurate air flow measurement with the unique CMR Venturi built into the airtight shut-off damper to control room pressure or constant volume.



Metal Damper

PPS EXTRACT DAMPER

Poly-propelene control and shut off valve incorporating the CMR Venturi Nozzle. This is essential when dealing with corrosive extract air especially from fume cupboard systems.



PPS Damper

PRECISION COMPONENTS FOR VENTILATION AND PROCESS CONTROL

CMR CONTROLS

A Division of C. M. RICHTER (EUROPE) LTD

22 Repton Court, Repton Close,
Basildon, Essex SS13 1LN. GB
Website: <http://www.cmr.co.uk>

Tel: +44 (0)1268 287222
Fax: +44 (0)1268 287099
E-mail: sales@cmr.co.uk

