cibse Journal

October 2024
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The magazine of the Chartered Institution of Building Services Engineers

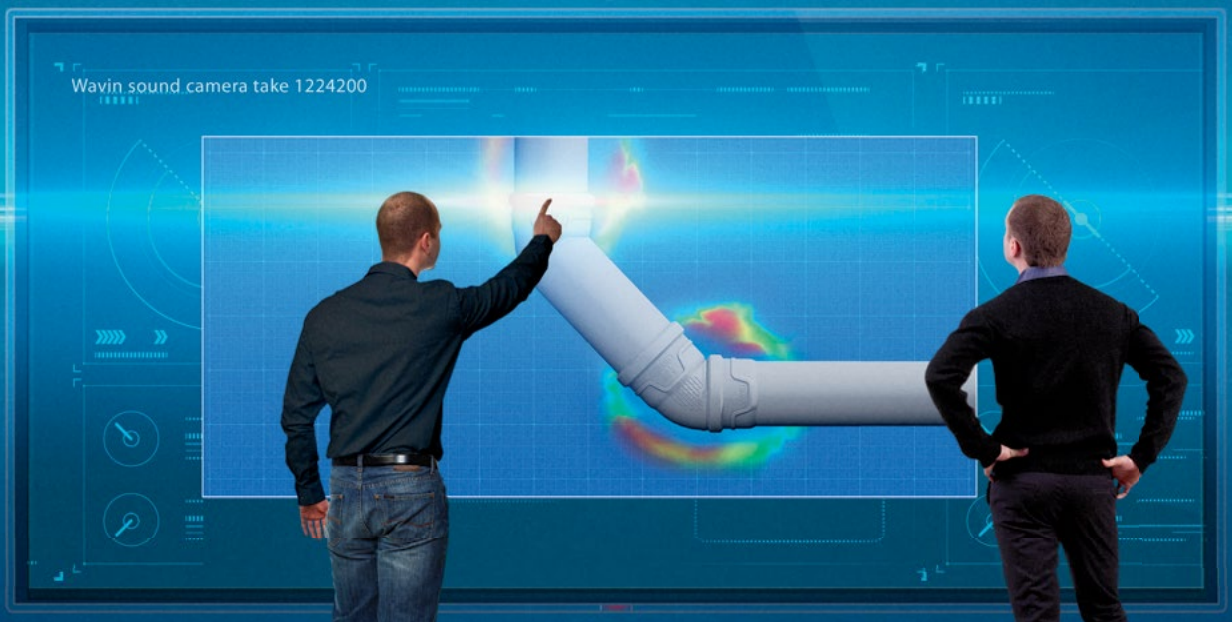
Grenfell Tower Inquiry recommendations

CIBSE YEN shares global stories

Hotel & Leisure Special

Hong Kong's digital shift

The pioneering projects using big data and AI to cut energy use and carbon



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Never forget

The publication of the Phase 2 Grenfell Tower Inquiry report was a bleak reminder of how dysfunctional the construction industry had become in the lead-up to the Grenfell fire. The authors found that a mixture of incompetence, dishonesty and greed among the organisations responsible for the safety of Grenfell Tower had led to the specification of combustible cladding and insulation on the external wall.

The report said those involved in the choice of the materials for the external wall thought responsibility for their safety lay with someone else.

A merry-go-round of buck passing, as described by Richard Millett KC, lead counsel for the Grenfell Tower Inquiry, is inexcusable, but not entirely surprising, when you consider how low a priority building safety had become within government departments.

The report said that from 1991–2007 there were many opportunities for the government to identify the risks posed by the use of combustible cladding panels and insulation. One example described the failure to heed a warning from the Environment and Transport Select Committee in December 1999 that, unless risks posed by external cladding systems were addressed, people would be killed.

At 1,700 pages, the Phase 2 Inquiry Report is a daunting read but a vital one. Chapters 3–14 lay out in detail the path to disaster and Volume 4's forensic analysis of the evidence from those called to the inquiry offers valuable lessons as to what can happen if safety is not considered at every stage of design and construction.

Thankfully, in recent years there has been a lot of good work undertaken by organisations on improving safety, including by CIBSE, and the Building Safety Act is at last forcing firms to take responsibility for safety. The fact it's taken a fire that killed 72 people to do so, is a depressing reflection of the priorities society considered most pressing at the turn of the 21st century. ●

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Key events

Conference

Building Performance Reimagined

8 October, Royal College of Surgeons

A look into CIBSE's transformative Building Performance Reimagined project, featuring a range of experts from across the industry.

bit.ly/BP24tic

Awards

CIBSE Young Engineers Awards

10 October, BMA House, London

The awards celebrate the very best and brightest engineering talent, rewarding graduates, undergraduates, apprentices and the employers who support and nurture them.

www.cibse.org/yea

To celebrate the dynamism and global reach of the Young Engineers Network, we are featuring articles from regions from all over the world in upcoming issues of the *CIBSE Journal*. Global YEN chair Ruth Tatanga (left) has commissioned three articles for this issue, including a groundbreaking smart project in Hong Kong that uses big data and artificial intelligence to slash carbon and energy. There are 17 YEN regions and more than 8,000 YEN members worldwide who benefit from events and meetings providing support, networking and knowledge sharing for those in the early stages of careers. You don't need to be a CIBSE member to join YEN – to get involved, visit moredetails.uk/3B7UN4I

YEN Takeover

Awards
The SFE Façade 2024 Design and Engineering Awards
6 November, Old Billingsgate, London

The awards recognise excellence and achievement in façade engineering, with new categories to include the Digital Innovation and Special Structures UK and International awards.
www.cibse.org/facadeawards

Exhibition and conference
Build2Perform Live 2024
13-14 November, ExCeL London

Join forward-thinking industry professionals, visionary speakers and leading exhibitors at this year's Build2Perform Live – which will include a new area for facilities management, Maintain2Perform, and the return of Light2Perform. **www.build2perform.co.uk**

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Grenfell Tower Inquiry urges sweeping reform

Report blames failure in government and accuses manufacturers of rainscreen cladding panels and insulation of 'systematic dishonesty'

The Prime Minister has warned that construction companies involved in failings that led to the Grenfell Tower fire will not be awarded government contracts, following the publication of the final report into the 2017 disaster.

The concluding report of the seven-year long Grenfell Tower Inquiry, chaired by retired High Court judge Sir Martin Moore-Bick, was published on 4 September. Among a host of recommendations is a call for the establishment of a construction industry regulator.

He or she would be responsible for construction product regulations, testing, fire risk assessor accreditations, building control oversight, and the licensing of contractors to work on higher-risk buildings (HRB).

The report accuses manufacturers of the rainscreen cladding panels and insulation products, used on Grenfell, of 'systematic dishonesty' in the way the products were tested and marketed.

Sir Keir Starmer said he took responsibility for the building safety issues identified in the report and that the government will write to the companies found to have been part of these 'horrific failings' as a first step to stopping them being awarded government contracts.

The report also calls on the government, working with industry and professional bodies, to encourage those in the industry to take courses in the principles of fire engineering as part of their continuing professional development.

CIBSE technical director Dr Anastasia Mylona said: 'The findings of the Grenfell Inquiry report are sobering and a stark reminder of the critical need for transparency, integrity and robust regulation within our industry.

'As the report highlights systemic failures, CIBSE remains committed to driving the necessary reforms in building and fire safety engineering practices.'

Other recommendations are highlighted on page 21.

Inquiry calls for independent regulator with teeth

The creation of a single construction regulator, reporting to a single secretary of state responsible for fire safety, is one of the key recommendations of the long-awaited final report of the public inquiry into the Grenfell Tower disaster.

The inquiry's phase two report says regulation of the construction industry had become 'too complex and fragmented'.

Building fire safety functions are currently split between the Home Office, the Department for Business and Trade, and the Ministry of Housing, Communities and Local Government.

The inquiry says the Building Safety Regulator, established in the aftermath of the Grenfell disaster, falls short of what is necessary to draw together responsibility for the construction industry's dispersed functions.

Responsibilities of proposed regulator

- Regulation of construction products
- Certification and testing of reaction to fire of materials and products intended for use in construction
- Regulation and oversight of building control
- Licensing of contractors to work on higher-risk buildings
- Monitoring of the Building Regulations and statutory guidance, and advice for the Secretary of State on the need for changes
- Exchanging information with fire and rescue services on matters affecting fire safety
- Accrediting fire risk assessors
- Maintaining a publicly available library of test data and publications
- Carrying out research on matters affecting fire safety in the built environment
- Collecting information, in the UK and abroad, on matters affecting fire safety.

Licensing 'should be mandatory' for safety work

Arup framework seeks to address fire safety challenges

Formal accreditation or licensing should be mandatory for all engineers, architects, consultants and fire risk assessors undertaking work that has an impact on fire safety, according to a new report by Arup.

The report outlines a framework of changes for tackling some of the systemic industry challenges identified during the Grenfell Tower disaster inquiry, published earlier this month, on which Arup advised.

Alongside mandatory accreditation, the report recommends setting specific competency requirements for those involved in fire safety work.

This would define the minimum qualifications, training and years of experience appropriate for particular roles and responsibilities, such as chartered engineer.

It also recommends that it should be a requirement that registered chartered engineers or consultants responsible for fire safety should have formal involvement and oversight of construction and commissioning of high-rise residential buildings.

This would include the formal sign-off and recording of their acceptance that the as-built meets the fire safety strategy or design intent.

The report also urges that a registered chartered fire safety engineer should be a requirement for the design and construction of high-rise residential developments or new works in such buildings.

Universities call for tuition fee increase

Tuition fees must be raised and maintenance grants reinstated for those from poor backgrounds, universities have urged.

The BBC has reported that Universities UK, which represents 141 higher education institutions, has recommended that tuition fees increase to stem growing deficits across the sector.

Tuition fees have been capped at £9,250 in England since 2017. But in order to keep up with inflation, funding per student would be £12,000 to £13,000, Universities UK estimates.

With numbers of higher paying foreign students declining as a result of visa restrictions, around 40% of universities are expected to record a deficit this year.

See article on degree apprenticeships on page 26.

Data centres classed as critical infrastructure

Data centres in the UK are to be classified as critical national infrastructure (CNI), the secretary of state for science and technology has announced. Peter Kyle said data centres will join the other 13 sectors classed as CNI, which include energy and water supplies. The classification means extra government support during a major incident, such as a cyber attack, an IT outage or extreme weather, in order to minimise disruption.

Government creates National Electricity System Operator

The National Grid has sold its energy system operator arm to the government, paving the way for the latter's launch next month as a public body. The new National Electricity System Operator (NESO) officially launches on 1 October after the government agreed to pay National Grid £630m. As well as overseeing operation of the Grid, NESO's remit will include the preparation of a Centralised Strategic Network Plan and the establishment of an office of resilience and emergency management.

High Court scuttles coalmine plans

The High Court has blocked plans for the UK's first new deep coalmine in 30 years. In a ruling, issued on 13 September, Justice Holgate ruled that plans to build the facility in Whitehaven, Cumbria, would not proceed. The judge agreed with a legal challenge by Friends of the Earth on the grounds that former secretary of state for levelling up Michael Gove, when giving permission for the project, had acted unlawfully by accepting a claim by developer West Cumbria Mining that the mine would have no impact on the country's ability to meet its targets under the Climate Change Act 2008, because it would offset emissions.

New bill extends Awaab's Law to private rental sector

Renters' Rights Bill also applies Decent Homes Standard to private rentals

New legislation will extend Awaab's Law, which gives tenants the right to challenge dangerous conditions in their homes, into the private rented sector.

The Renters' Rights Bill, introduced into parliament on 13 September, implements Labour's election manifesto pledge to ban Section 21 so-called 'no fault' evictions for new and existing tenancies.

Other moves in the bill include extending Awaab's Law to the private rented sector. It was introduced by the previous government after an inquest found that two-year-old Awaab Ishak died in December 2020 from a severe respiratory condition caused by prolonged exposure to mould in his home.

Awaab's parents had repeatedly complained to their landlord, Rochdale Boroughwide Housing, about black mould in their kitchen and bathroom and had asked to be rehoused but were ignored.

A consultation on Awaab's Law, launched by the last government, proposed strict new time limits to force social housing providers to take swift action in addressing dangerous hazards such as damp and mould.

The consultation also proposed new legal requirements for social landlords to investigate hazards within 14 days, start fixing them within a further week and make emergency repairs within 24 hours.

The new renters bill applies the Decent Homes Standard, which currently covers social housing, to the private rented sector for the first time.

Landlords failing to address serious hazards can be fined up to £7,000 by local councils and may face prosecution for non-compliance.

June deadline for CE marking cancelled

The government has cancelled the June 2025 deadline for ending recognition of the European Union's construction product safety kitemark regime in the UK.

The previous government had said that the CE (Conformité Européenne) marking scheme, which was to be replaced by the new UKCA scheme, was no longer due to be recognised for construction products from next June.

But in a statement to the House of Commons, junior building safety minister Rushanara Ali said the recognition period for the CE mark will be extended.

She said the findings of the Independent Review of the Construction Products Testing Regime showed there is currently 'insufficient' testing and certification capacity in the UK for the UKCA to replace CE recognition. Ali added that ending recognition without reforming the UK's domestic regime would create trade barriers and negatively affect the supply of products that meet recognised standards.

CIBSE reveals Employer of the Year finalists

The awards will be presented at the CIBSE Young Engineers Awards at BMA House on 10 October

The shortlist for the CIBSE Employer of the Year has been revealed ahead of the annual Young Engineers Awards, taking place at BMA House in London on 10 October.

Last year's overall Employer of the Year, Aecom, has been shortlisted again for the large company category, competing alongside Hoare Lea and AtkinsRéalis.

Shortlisted in the medium category are ChapmanBDSP, PM Group, and FairHeat, while SI Sealy & Associates, Bennett Freehill and Venables Associates compete in the small company category.

The award is handed to those firms that champion young people in the building services sector, both in the workplace or by supporting those employees through education.

The CIBSE Young Engineers Awards, will also see four talented new engineers presented with awards, with categories for Apprentice of the Year (Levels 3–4 and 5–7), Undergraduate of the Year and Graduate of the Year.

The nine shortlisted entrants for the Graduate of the Year will make a presentation to judges and a live audience on the following topic: 'What do you consider as the main implications for building performance of changing demographics, lifestyles, and the need to keep people safe, healthy and productive?'

For details of the shortlisted engineers, turn to page 25.

Call for accreditation of HP installers

Mandatory accreditation of heat pump installers should be introduced, a coalition of energy bodies has urged.

The UK Heating Trades Network UK (HTNUK), charity National Energy Action, the MCS Foundation and thinktank Energy and Climate Intelligence Unit have called for the mandatory accreditation of all heat pump installers in the UK.

Research by *Which?* magazine found that 45% of households are unsure about the required qualifications for heat pump installers, while 55% struggle to trust the information provided.

The energy organisations believe accreditation will help to establish clear, consistent standards for installation and protect consumers.

Glamox

SLIMLUX Adaptive

Reduce Cat A and B waste

SLIMLUX Adaptive is engineered to minimize material waste commonly seen between Cat A and B installations. This modular, connective and adaptable lighting system embodies the principles of a circular economy, making it an ideal choice for offices, light industrial spaces, and retail environments.

Load bearing or standalone

SLIMLUX Adaptive is engineered to support load-bearing functions, making it ideal for suspending acoustic metal tiles or rafts directly from the Adaptive power profile. SLIMLUX Adaptive also excels as an independentlysuspended system, perfect for open office environments where alternative or no acoustic requirements are needed.

Key Features

- Load bearing or standalone version
- Easy installation and connection
- Lumen output (lm): 2900 – 4500
- Up to 175 Lumens per circuit Watt
- Colour temperature: 3000-6500K
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- Selection of accent and decorative luminaires
- Driver lifetime up to 100,000 hr at Ta 25°C
- Integrated Emergency
- Transform the product to your requirements

FIND OUT MORE

www.glamox.com/uk

CIBSE reveals office move to Farringdon

Ruth Carter says head office in central London is a building to be proud of

CIBSE has purchased a new head office building in Farringdon, central London.

The 17,000sq ft, six-storey building at 91–94 Saffron Hill is 70% larger than CIBSE's current head office in Balham and has a variety of flexible spaces, including a mezzanine.

CIBSE chief executive Ruth Carter said: 'This building is a beauty, and looks even better in real life. We have a head office to be proud of.'

The offices are arranged over the lower-ground, ground and three upper floors. The second and third floors are linked, and benefit from a vaulted ceiling with large glazed sections and a double-height space.

CIBSE Members will be able to use the ground and lower ground floors, which will be turned into a 100-capacity theatre, and have areas for training, working and relaxing.

Carter said: 'CIBSE has a huge umbrella of networks that could use the building. The building will be their hub in town.'

The office is only a three-minute walk from the new Elizabeth Line at Farringdon, putting Heathrow and major railway stations within easy reach.

Carter said the aim was to move staff into the building from Balham by December this year.

See page 18 for more on the new head office.

Five heat networks win £57m grants

A project to regenerate Leeds' South Bank has won the lion's share of the latest allocation from the government's Green Heat Network Fund.

The fund's administrator, Triple Point, has announced that five heat networks connecting to major developments will share £57m. The biggest award is £24.5m for an extension to the LeedsPIPES network, which is powered by local waste heat. This will allow the connection of an additional 8,000 homes and buildings in the South Bank regeneration project.

Three projects across London will receive £20.2m to connect 8,500 new homes and businesses across new developments to low carbon heat networks powered by air and ground source heat pumps. And £12.6m is going to Barnsley to support the commercialisation and construction of a multi-source heat pump network across a range of businesses and public sector buildings.

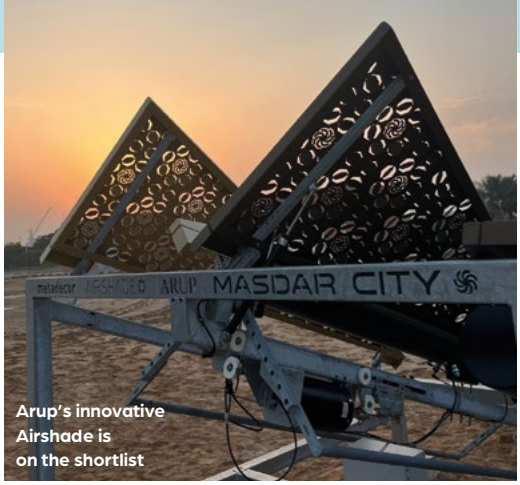
The project also plans to explore the capture of waste heat from a nearby industrial manufacturing plant as the network expands and densifies.

The five projects will provide low carbon heat to 17,000 new homes, commercial spaces, and public buildings, saving more than save 385,000 tonnes of CO_2.

cibse News

Façade awards shortlist includes world firsts

SFE and CIBSE reveal finalists across 12 categories



Arup's innovative Airshade is on the shortlist

The world's first air-powered shading system for buildings, the world's largest spherical structure, and the UK's first major mixed-use, fossil fuel-free development have all made the shortlist for the Façade 2024 Design and Engineering Awards.

The awards, run by the Society of Façade Engineering (SFE) and CIBSE, recognise excellence and achievements in façade engineering, raising the profile of, and drawing attention to the importance of this discipline.

More than 50 projects and products have been shortlisted across the 12 award categories, including the Las Vegas Sphere, a multifunctional entertainment space, which features 14,500m^2 of LED screens, and is the world's largest spherical structure.

Also breaking records in the New Build Award category is the Arbor building, which is net zero in operation and part of London's Bankside Yards estate set to be the UK's first major mixed-use fossil fuel-free development.

As well as categories for New Build, and Refurbishment, the new categories for Digital Innovation and Special Structures UK and International have been introduced for 2024.

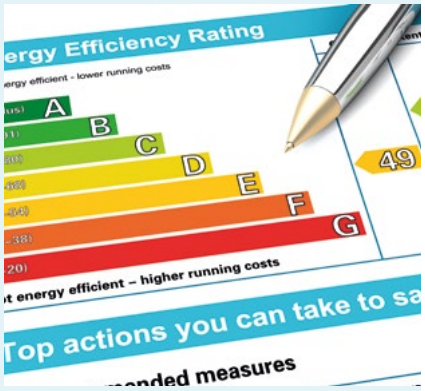
The Digital Innovation Award rewards the very best digital innovation product or project that supports façade engineers. The Special Structures Awards recognise smaller interventions such as a bridge, canopy or sculpture. The Special Structures International Award shortlist features the world's first air-powered shading device, the Airshade, developed by Arup, in Masdar City, UAE.

Saverio Pasetto, chair of judges, said: 'The huge diversity of projects in this year's shortlist, from art galleries, to libraries, Grade II listed buildings, hospitals and entertainment spaces, highlights the wide-reaching impact of façade engineering in our spaces and buildings.'

The headline sponsor for the awards is Reynaers Aluminium. The awards will take place on 6 November at Old Billingsgate, London.

To view the shortlist in full, and to book your place visit: bit.ly/CJexprou

Training



Low carbon consultant building design

Upcoming dates: 15–16 October, 19–20 November

This course is for those wishing to become a low carbon consultant (LCC), and anyone wishing to gain certification as a low carbon energy assessor (LCEA) able to produce Energy Performance Certificates. Over the course, attendees will gain an understanding of legislative framework, Building Regulations Part L, energy performance certification, low and zero carbon technologies and factors affecting building efficiency.

For full details and booking:
www.cibse.org/training

Introduction to heat networks code of practice
9 October

Low carbon consultant building design
15 October
19 November

Emergency lighting to comply with fire safety requirements
15 October

Heat networks code of practice (CP1) short update
16 October

Fire safety building regulations: Part B
16 October
26 November

Air conditioning inspection
17 October

Overview of IET wiring regulations
17 October

Energy strategy reports
22 October

Mechanical services explained
22 October

DEC theory and ORCalc software training
23 October

Introduction to the Building Safety Act
29 October
27 November

Mentoring skills workshop
31 October

Mechanical services overview
4 November

Electrical services explained
5 November

Building services explained
5 November

Fire safety in purpose built blocks of flats
5 November

Understanding the law for engineers
8 November

The electrification of heat
11 November

Mechanical services explained
12 November

The importance of energy efficient buildings
12 November

Energy efficiency related Building Regulations Part L
13 November

Part O Overheating
14 November

Standby diesel generator
15 November

ISO 5001:2018 Energy management system/low carbon consultant
19 November

Commissioning Code M: Commissioning management
20 November

Low and zero carbon energy technologies
21 November

Advanced simulation modelling for design for performance
21 November

Energy surveys
26 November

Heat networks code of practice (CP1)
26 November

Low carbon consultant building operations
27 November

Energy Savings Opportunity Scheme (ESOS)
28 November

Design of ductwork systems
3 December

Introduction to heat networks code of practice
3 December

Design of heating and chilled water pipe systems
5 December

Build2Perform Live to showcase Nabers UK

CIBSE Certification took over administration of commercial build rating scheme in April

A seminar to promote Nabers UK will take place at this year's Build2Perform Live event, CIBSE has announced.

The energy rating system for offices was launched in November 2020 and is based on the successful Nabers scheme in Australia.

CIBSE Certification, a subsidiary of CIBSE, has administered the scheme since April. It offers certification of management systems, personnel, and embodied carbon verification.

The Nabers UK scheme rates the energy performance of office buildings and is designed to close the performance gap in buildings and to ensure that predicted energy performance is matched by the actual building performance.

There are two product offerings available: Nabers UK Design for Performance, which aims to drive energy efficiency in new buildings, and Nabers UK Energy for Offices ratings, which measures the energy efficiency of existing buildings.

The scheme also includes Nabers UK Assessor training, and registration of assessors, with robust processes for supervising their initial submissions. CIBSE Certification has accepted new training, assessor registration, DfP, and Energy for Office applications from 1 July.

Working alongside Nabers UK and scheme ambassador, the BBP, CIBSE Certification has introduced changes that provide a clearer separation between Nabers UK training, and the assessor registration and qualification process. It also better aligns sizes of offices with likely future UK mandatory reporting requirements.

While new applications are growing, the transfer of previously registered agreements from the BRE, the scheme's previous administrator, continue.

Visit Build2Perform Live www.build2perform.co.uk Nabers UK is at www.cibse.org/nabers-uk

In October

Webinar

Ensuring Wellbeing and Sustainability in Building Services

2 October

This webinar offers key insights into CIBSE Guide M15: Wellbeing, exploring how building services contribute to healthy, comfortable indoor environments that enhance occupant wellbeing. Attendees will learn about best practices for maintaining and improving IEQ while minimising energy use.

Register at bit.ly/CJWSWeb

Seminar

Impact of sustainability finance regulations on building energy performance

15 October, Savills, London and online

The CIBSE Young Energy Performance Group and Energy Performance Group event, hosted by Savills, will look at how sustainable finance regulations are driving the demand to build and refurbish more sustainably.

bit.ly/CJSusFin

Competition

Ready Steady Light 2024

15 October, Sidcup

The annual Society of Light and Lighting competition, in partnership with Rose Bruford College and the IALD, where teams of lighting professionals are challenged to create a exterior light installation in three hours.

bit.ly/CJRSL2024

Awards

CIBSE ANZ Awards

24 October, Sydney, Australia

The CIBSE ANZ Young Engineers Awards celebrate emerging thought leaders in the building services industry and the people and organisations that support them.

bit.ly/CJAnz24

New Experience route to membership and registration

CIBSE has launched a new Experience route to help professionals with 2–5 years of experience achieve CIBSE membership and professional registration.

Tailored for engineers with practical experience who do not hold the academic requirement, this route provides a flexible path to achieving professional recognition and chartered status as a Chartered Engineer (CEng) or Incorporated Engineer (IEng).

The route has been designed to accelerate the path to membership and/or professional registration.

The route recognises experience and is designed for those with substantial real-world technical expertise. It accelerates the journey to CIBSE membership and/or professional registration, with a streamlined application and assessment process.

It also saves on application fees while gaining access to all membership benefits.

● For more information: cibse.org/registration

CIBSE Careers Fair comes to East London

The CIBSE Careers Fair returns to London on 5 November.

Hosted at Here East UCL at Here East, on the Queen Elizabeth Olympic Park, it will provide an opportunity for students to meet employers, and for firms to showcase career opportunities and inspire the next generation of engineers.

There will be opportunities to speak to the CIBSE membership team about accessing the latest career guidance, research, and starting the path toward professional registration and becoming a Chartered Engineer.

CIBSE's official recruitment partner, Hays, will also be on hand to offer CV advice.

● More information at bit.ly/CJcar24

Simulation Awards open for entry

Entries are now open for the 2024 CIBSE Building Simulation Awards.

The awards, organised by the CIBSE Building Simulation Group, encompass the Building Simulation Award and the Building Simulation Young Modeller Award.

The former focuses on the use of building simulation in projects, and aims to encourage innovation in building simulation techniques. The Young Modeller Award recognises the outstanding contributions of young engineers, apprentices and sustainability consultants working with building performance simulation.

Entries will be reviewed by a panel of experts, and the finalists will present their projects in front of an audience and judging panel at Build2Perform Live in November.

Deadline for submissions is 6 October.

To submit your entry, visit www.cibse.org/BSA
For more information, contact buildingsimulation.competition@cibse.org

New CIBSE Education Guild invites volunteers

Forum designed to enhance engineering education

The CIBSE Education Guild is inviting volunteers to join its committee and attend an inaugural meeting.

The CIBSE Education Guild has been established as a forum for those committed to delivering suitable education to meet the needs of the building services engineering profession and the broader community.

By fostering collaboration, innovation and excellence in education, the Guild aims to support the development of highly skilled and knowledgeable professionals who can positively contribute to society and the built environment.

The committee is open to anyone with an interest in engineering education and a number of committee officer positions are available.

The chair and treasurer must be corporate members of CIBSE, whereas the secretary can be any grade of membership; the vice-chair and other members of the committee do not have to be CIBSE members.

To volunteer complete the form at: **bit.ly/CJEdGuild**.

The first meeting of the CIBSE Education Guild will take place on 16 October, online and at UCL London. More information about the Guild can be found at **bit.ly/CJGIEdGuild**

Lessons from low carbon education

A Welsh comprehensive school is expected to save £17–19,000 a year after installing a Mitsubishi Electric heat pump, says the company's Graham Temple

Research shows that the majority of children and young adults are 'very' or 'extremely worried' about climate change. Today, that also means they expect more from the establishments offering them an education, at whatever level.

Legislation also affects schools and universities; the Minimum Energy Efficiency Standard (MEES) establishes a minimum level of energy efficiency for buildings in England and Wales. It is therefore more important than ever that schools and colleges understand not only how to comply with the regulations, but also what they can do to reduce the carbon footprint of their buildings.

To this end, the Welsh Government has helped a Ruthin school decarbonise its heating by replacing gas boilers with renewable air source heat pumps. Ysgol Brynhyfryd is a bilingual, co-educational comprehensive school for more than 1,000 pupils aged between 11 and 18 in Clywd, North Wales. The school is maintained by the Denbighshire Education Authority, which, in 2019, declared a climate and ecological emergency, and to work to net zero by 2030.

The carbon reduction solution was to install 70kW of solar photovoltaic panels on the school roof, and replace three gas boilers with two 40kw CAHV air source heat pumps from Mitsubishi Electric, feeding underfloor floor heating throughout the building.

It is estimated that the school will save an average of £17–£19,000 per annum, along with 28 tonnes of carbon.

The CAHV heat pumps achieve 70°C water temperatures down to -20°C ambient temperature to deliver continuous heating. Multiple unit cascade control offers capacity from 7.8kW to 640kW to make the system suitable for a wide range of applications.

The efficiency of the heat pumps installed should be around 300 to 400%, so for every one kilowatt of electricity consumed, it will deliver 3 to 4kW of heat to the building.

If you would like to see a video of the installation, please visit: bit.ly/CJMEYB24
Find out more about HVAC for education here: bit.ly/CJMEHVACEd

Graham Temple is marketing manager at Mitsubishi Electric

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The challenge ahead

Climate change, building safety and the emergence of artificial intelligence are three huge issues defining the role of the engineer. **Anastasia Mylona** describes these and other technical challenges for 2025–30

Looking back over the past five years, would we have anticipated the significant changes and challenges that our industry is now facing? The introduction of the Building Safety Act, the imminent launch of the Net Zero Carbon Buildings Standard (NZCBS), and the artificial intelligence (AI) revolution are just a few of them.

CIBSE needs to think about the resources and knowledge members need to address these challenges. These are the technical areas I believe we should focus on in the next five years.

Building Safety Act

The publication of the Phase 2 Grenfell Inquiry report, and the recent fire at a block of flats in Dagenham, have again brought fire safety into the spotlight.

The introduction of the Building Safety Act is a significant step forward, but we must continue to prioritise fire safety – not just in new buildings, but also in the refurbishment of existing ones – to prevent future tragedies. The CIBSE Fire Safety Working Group, led by David Fitzpatrick, will identify the next steps for CIBSE in providing technical support and guidance to our members and the wider industry, to comply with the act and deliver safe buildings.

Net Zero Carbon Buildings Standard

The NZCBS, due to be launched in autumn, brings together net zero carbon requirements for major building types, based on a 1.5°C global temperature change trajectory. The standard will enable industry to prove that its built assets are net zero and in line with our nation's climate targets.

Based on measured data, the standard, of which CIBSE is a founding member, will set out metrics by which net zero carbon performance will be evaluated, as well as performance targets – or limits – including for energy use, upfront embodied carbon, and life-cycle embodied carbon. It will cover carbon accounting, procuring renewable energy, and the treatment of residual emissions. (**www.nzcbuildings.co.uk**)

CIBSE will remain at the forefront of providing technical guidance and training towards meeting the standard and supporting its implementation.

"We must continue to prioritise fire safety to prevent future tragedies"

Intelligent buildings

Smart controls and building management systems are widely used in buildings, but we still don't fully understand how to integrate them, how to learn from the data, and the cybersecurity implications. AI in building design and operation, and human and AI integration, are concepts with which our industry is starting to get familiar.

A new generation of engineers with expertise outside of traditional M&E skills will be needed to bring new ways of thinking, integrate technologies and learn from data. CIBSE's Society of Digital Engineering and Intelligent Buildings Group are leading the Institution's response to these advances.

Retrofit

We still have substantial existing building stock that is underperforming and exposed to risks. CIBSE recently published the results of the Retrofit Revisit 2024 research (**bit.ly/CJRR24**), which presented lessons learned in the refurbishment of existing homes. We anticipate retrofit to stay relevant for many years to come.

Areas of focus for CIBSE will include retrofit strategies that prioritise health, wellbeing and safety, energy security, resilience to a changing climate, and flexibility of use.

Decarbonisation of heating and cooling

Decarbonising UK building stock will be essential for meeting our net zero targets. The policy focus is currently on decarbonisation of heat, with incentives to promote technologies such as heat pumps and heat networks.

CIBSE has responded with guidance, including CP1, AM16 and AM17, and is working with the Domestic Building Services Panel and key industry partners to provide guidance on the design and installation of heat pumps in single family homes. The carbon implications of such technologies will need to be taken into account. The potential increase in the uptake of cooling, particularly in homes, will threaten our net zero targets.

CIBSE is due to launch new weather files to assist in assessing overheating risk. It is also promoting sustainable cooling strategies and supporting Part O. We will work with partners in hot regions to inform our knowledge of sustainable cooling strategies that could be adapted for the UK.

References:

[1] Research into overheating in new homes report, 2019, MHCLG

Anastasia Mylona is the technical director at CIBSE

Moving with the times

CIBSE is leaving Balham and relocating to a new head office in Farringdon. CEO **Ruth Carter** tells **Alex Smith** the flexible new space embodies CIBSE's forward-thinking vision and will serve as a dynamic hub for members and staff

After 44 years, CIBSE is moving back to central London, following the purchase of a new head office in the vibrant cultural and business district of Farringdon.

The acquisition of 91–94 Saffron Hill comes two years after CIBSE CEO Ruth Carter announced that the Institution was planning to sell its Balham premises and move to a new location that would better serve the interests of staff and members. At 17,000sq ft, the six-storey building is 70% larger than Balham, and has a variety of flexible spaces that will be able to accommodate the multiple requirements of CIBSE's varied and growing membership.

'This is a building that CIBSE can be proud of,' says Carter, who spearheaded the move. 'When we think about CIBSE being insightful, leading and challenging – and providing omnipotent guidance – this is the perfect building to embody that vision.'

"We have a huge umbrella of networks that could use the building. It's their hub in town"

The offices are arranged over the lower-ground, ground and three upper floors. The second and third floors are linked, and benefit from a vaulted ceiling with large glazed sections and a double-height space. There will be around 60 desks on the upper two storeys for CIBSE's 75 staff, as well as meeting rooms and breakout spaces, which will encourage collaboration and flexible working.

CIBSE had three main objectives when choosing the new head office: it had to meet the Institution's requirements, be centrally located for staff, and have the opportunity to reach its decarbonisation goals/aims. It also had to suit CIBSE Members and partners, be affordable, support modern, global working practices, and act as a net zero demonstration project.

With the members' community in mind, the ground and lower-ground floors will be remodelled into a theatre with capacity for 100 people, plus an area that will feature training rooms, workspaces, a space to relax, showers and a kitchen. The theatre will be ready for the 2025 CIBSE AGM.

Carter envisages the ground floor being a dynamic hub for CIBSE. 'We have a huge umbrella of networks that could use the building. Members might have meetings during the day and a black-tie event in the evening. They can get

changed for the evening, leave their luggage here, and call this place their home while they are in London.'

CIBSE will run the space as a members' area for a year and, if it proves popular, will invest in more facilities. 'The flexibility of the building allows us to expand and adapt as needed,' Carter adds.

The building is only three minutes' walk from the Elizabeth Line tube at Farringdon Station and its central London location was a major plus for Carter. 'Connectivity is through the roof at Saffron Hill. It's so easy to get to from London's major transport hubs – 29% of our members are from outside the UK and, if they land at Heathrow, they can get the Tube directly here,' she says.

The location of the Balham office, multiple stops down the Northern Line, was one of the main reasons Carter wanted to relocate rather than refurbish. 'I once said to someone at Hoare Lea "have you been to Balham?", and he said yes – but he also said it may well have been Ulan Bator [the capital of Mongolia],' she says.

'There was a plan to sell off the engineering centre at Balham and refit the main building, but the issue was that it was still going to be Balham.'

With its mix of business, cultural and creative industries, Farringdon – which has been rapidly gentrifying since the 1990s – has the 'white noise of buzz and energy' that Carter says Balham lacks. The area will have another major boost in 2026 with the opening of the London Museum at nearby Smithfield Market. The transformation of the historic market into a world-class cultural destination is featured on page 38.

CIBSE's new property is located on the western side of Saffron Hill, near the junction with St Cross Street, and is close to London's famous Hatton Garden jewellery quarter. The immediate vicinity now boasts an array of retail and leisure offerings, including Leather Lane Market.

The area also has a literary history – Saffron Hill was the location of Fagin's hideout in Charles Dickens' *Oliver Twist*. The hostelry that inspired the Three Cripples pub, where Bill Sykes drank, is a few doors down from CIBSE's new home.

The move offers the Institution an opportunity to use its expertise to share best practice in decarbonising a commercial property. 'I want the solutions to work in the real world,' says Carter.

The building has an Energy Performance Certificate rating of B, so there is room for improvement, but there will be no dramatic services overhaul in the short term. 'We're not going to throw away the boiler immediately,' Carter says. 'I want to live in the building for at least a year, taking measurements, and then develop a decarbonisation strategy.

'We can't just think about operational energy – we must think about embodied energy too. We might find some interventions aren't necessary. I don't want to rush in, spend a huge amount of money, then question what we've done. We will have broad decarbonisation targets when we move in, but how and when we get there will be determined by living in the building.'

Carter is keen to share the decarbonisation journey with members: 'We want to live this publicly – we want people to know what we tried, what's worked really well, and what hasn't.'

The deal for the premises was concluded last month, and Carter is keen to move to Saffron Hill as soon as possible. She is looking forward to opening its doors to members and the wider industry, and discussions have already taken place with Clerkenwell Design Week about hosting festival events.

'This building is a beauty, and looks better in real life. We have a head office to be proud of,' says Carter ●

Originally two buildings dating back to 1957, the site was extensively refurbished by architect Tooley Foster in 2010. The rear of the building is on Hatton Place

The premises advisory committee

The relocation of CIBSE's head office has been driven by the premises advisory committee, chaired by past CIBSE vice-president Paddy Conaghan.

Its members set the parameters for the type of building CIBSE was looking for after sub-groups had looked at finance and funding, building performance, FM, communications, and people and culture.

Carter says: 'We have used our CIBSE skill sets and reached out to special interest groups and societies to gather information.'

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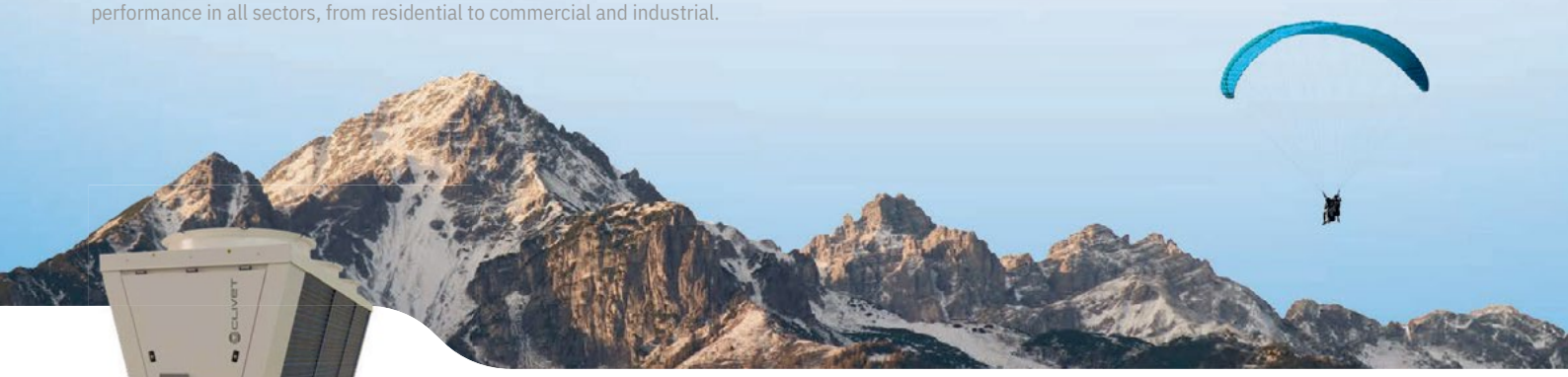

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A disaster waiting to happen

The Grenfell Tower Inquiry highlighted widespread failures across government and industry in the lead-up to the tragedy of 14 June 2017. **Alex Smith** highlights the key findings and recommendations from the Phase 2 report

The long-awaited Phase 2 report from the Grenfell Tower Inquiry has concluded that the devastating fire that killed 72 people on 14 June 2017 was the culmination of decades of failure by central government and other bodies responsible for the safe use of combustible materials in high-rise residential buildings.

Organisations contributed to the disaster 'in most cases through incompetence but in some cases through dishonesty and greed', said Inquiry chairman the Rt Hon Sir Martin Moore-Bick.

The seven-volume report identifies the many failings of a wide range of institutions, entities and individuals that together resulted in the Grenfell Tower fire. It makes recommendations that aim to ensure such as Grenfell never happens again.

The report's authors were scathing of the government from 1991 to 2017, saying it had many opportunities to identify the risks posed by use of combustible cladding panels and insulation. It said the Department for Communities and Local Government (now the Ministry of Housing, Communities and Local Government) was aware of the risks but did nothing, despite what it knew.

For example, the department failed to act on the results of a large-scale test in 2001 involving aluminium composite panels with unmodified polyethylene cores, which burned violently.

The report said the department knew that Approved Document (AD) B, governing fire safety, was unclear and not properly understood. And, by February 2016, it had become aware people were worried that combustible insulation and aluminium composite material (ACM) panels with unmodified polyethylene cores were being used on high-rise buildings.

Of the British Research Establishment (BRE), the report said that, from 1991, much of its work on testing the fire safety of external walls was marred by 'unprofessional conduct, inadequate practices, a lack of effective oversight, poor reporting and a lack of scientific rigour'. It said weaknesses in how the BRE carried out tests in accordance with BS 8414, exposed it to unscrupulous product manufacturers.

The report was scathing of both the makers of the rainscreen cladding panels and insulation, which it said engaged in deliberate and sustained strategies to manipulate and mislead the market, and certification bodies. It said the British Board of Agrément (BBA) and Local Authority Building Control, failed to ensure product certificates were accurate and based on test evidence.

The inquiry found that, from 2007 to 2017, Arconic Architectural Products had deliberately concealed the true danger of using Reynobond 55 PE in cassette form, particularly on high-rise buildings. It said it caused the BBA to make statements on the certificate that Arconic knew were false and misleading.

The Royal Borough of Kensington and Chelsea (RBKC) and the Tenant Management Organisation (TMO) were responsible for managing fire safety at Grenfell and the report found there were chronic and systematic failings in the TMO's management of fire safety and an absence of rigorous scrutiny by RBKC of TMO's health and safety obligations.

Despite fire safety strategy being recommended by an independent fire safety consultant in 2009, no strategy was approved by the time of the fire. The report found the TMO's fire assessor was not qualified for the role, and failed to take action in response to risks identified.

The choice of combustible materials for the cladding, said the report, resulted from errors caused by the incompetence of organisations and individuals involved in the refurbishment. It said architect Studio E, contractor Rydon and cladding subcontractor Harley Facades took a 'casual approach to contractual relations'.

Everyone involved in the choice of the materials for the external wall thought responsibility for their safety lay with someone else, said the report, and that the risks of using combustible

materials in the external walls of high rises were well known.

The report said Studio E was responsible for the design of the external wall and choice of materials and that: '[Its] failure to recognise that ACM was dangerous and to warn the TMO against its use represented a failure to act in accordance with the standard of a reasonably competent architect.'

The report said the architect 'bears a very significant degree of responsibility for the disaster'.

Rydon and Harley were also said to bear considerable responsibility as they both gave inadequate thought to fire safety and neither had sufficient knowledge of AB.

The report went on to criticise fire engineer Exova, saying it bore a 'considerable responsibility for the fact that Grenfell Tower was in a dangerous condition on completion of the refurbishment.' It said the firm had failed to prepare a final version of the fire safety strategy.

Recommendations

Chief among the recommendations is the call for a single, independent body that would report to a government minister responsible for building safety. The proposed body would have a remit that goes beyond the existing Building Safety Regulator.

Its responsibilities would include the regulation of construction products, testing of materials for fire safety, the regulation of building control, accreditation of fire risk assessors and licensing of contractors working on HRBs.

It said the new regulator would enable information to be shared more quickly and more effectively and policy to be developed 'in a holistic and coherent way'.

The report recommends that statutory guidance generally, and AB in particular, be reviewed and a revised version published as soon as possible. It also said new guidance should have a clear warning saying that compliance with the guidance document AD B, does not necessarily mean compliance with Building Regulations.

The report recommends an urgent review of the definition of HRBs as being either at least 18m tall or having seven storeys and containing at least two residential units. It says this definition is 'arbitrary' and unsatisfactory.

The report recommends that the profession of fire engineer be recognised and protected by law, and an independent body established to regulate the profession. It also recommends the AD make it clear that a qualified fire engineer calculate the likely rate of fire spread and the time required for evacuation.

The report said a fire safety strategy should be produced by a registered fire engineer and submitted with building control applications at Gateway 2 for HRBs and for it to be re-submitted at the stage of completion at Gateway 3.

CIBSE reaffirmed its commitment to building safety following the report's publication. CIBSE's technical director, Dr Anastasia Mylona, said: 'As the report highlights systemic failures, CIBSE remains committed to driving the necessary reforms in building and fire safety engineering practices.' ●

See panel for 'CIBSE's actions on building safety'

CIBSE's actions on building safety

Since the Grenfell Tower tragedy, CIBSE has been actively involved in advancing building safety across the industry through several initiatives:

- **Legislation and guidance: CIBSE has participated in consultations on new legislation and guidance, contributing to robust safety frameworks**
- **Supporting industry standards: CIBSE has supported the British Standards Institution (BSI) in creating the BS8670 Core Criteria for Building Safety Competence Frameworks**
- **Enhancing competence: CIBSE played a key role in the Raising the Bar' initiative and the updated UK Spec 4, requiring higher competence levels**
- **Training and education: CIBSE offers training courses such as 'Introduction to the Building Safety Act'. An keynote on Building Regulations will be given at Build2Perform Live on November 14**
- **Dedicated resource: CIBSE has established a Building Services Fire Safety Working Group to lead and inform technical guidance.**

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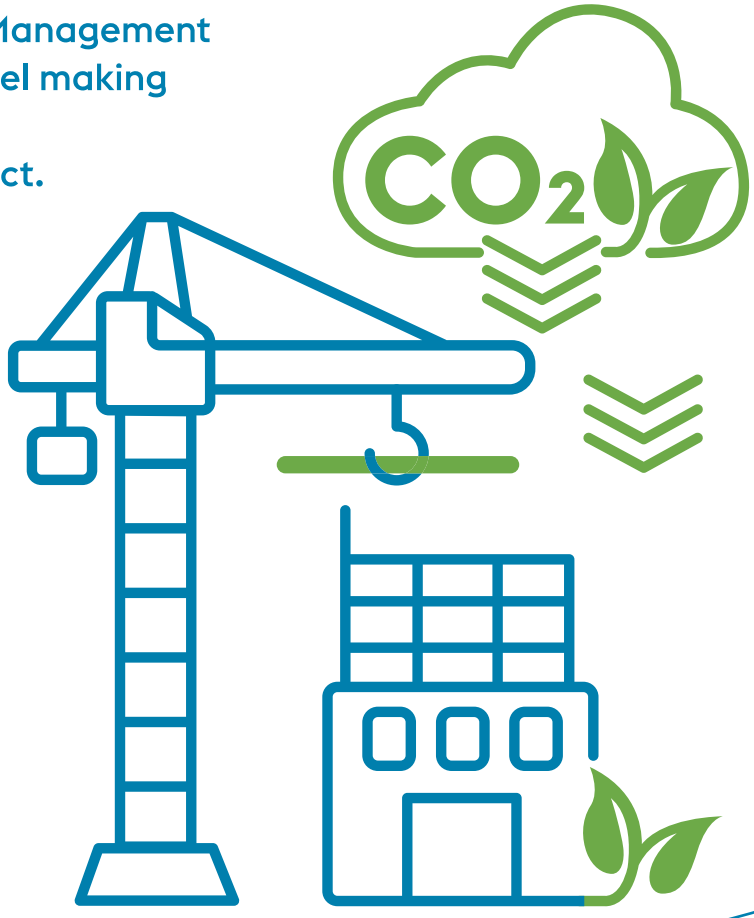

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YEA finalists vie for glory

Young engineers and the employers nurturing their talent will be recognised at the CIBSE Young Engineers Awards held at BMA House, London on 10 October

The shortlists have been announced for the prestigious CIBSE Young Engineers Awards, which are taking place at BMA House in London on 10 October.

The individual engineer awards recognise the building services industry's most talented apprentices, undergraduates and graduates, while the CIBSE Employer of the Year competition rewards those doing the most to develop those who have chosen a career in building services (see page 9 for employer shortlist).

Graduate of the Year

Nine engineers have been shortlisted for the CIBSE ASHRAE Graduate of the Year award, now in its 29th year. They will present in front of judges and a live audience on the topic: 'What do you consider as the main implications for building performance of changing demographics, lifestyles, and the need to keep people safe, healthy, and productive?'

The engineer who is deemed to have given the best presentation will enjoy a fully paid-for trip to the ASHRAE Conference, which will be held in Orlando, Florida, next year. Second place will win a £600 cash prize provided by CIBSE Patrons, and third place will win a £300 cash prize from the Manly Trust.

Last year's Graduate of the Year Francesca James, a consulting engineer at FairHeat

Apprentice of the Year

The hotly contested Apprentice of the Year is split into Technician Apprentices (level 3–4) and Degree Apprentices (level 5–7).

The awards recognise the valuable skills gained from apprenticeships – practical and relevant work experience.

The shortlisted engineers have been judged on a video presentation, which for Technician Apprentice (level 3–4) answered the question: 'How can building services engineers build towards the 2050 targets?' For the Degree Apprentice (level 5–7) award, the question was: 'What skills are needed to maintain a net zero carbon future?'

Undergraduate of the Year

Previously known as the President's Prize, the Undergraduate of the Year will be judged on the entrant's 450-word abstract and three-minute video of their final-year project.

The award is open to CIBSE student members in their final year of BSc, BEng, MSc and MEng study. It is designed to encourage students to develop potential and strive for excellence.

First place will win £500, while second and third place will receive £100.

The awards are sponsored by CIBSE Patrons and Eaton. To attend visit www.cibse.org/yea

CIBSE ASHRAE Graduate of the Year 2024 shortlist

Jack Beech, Liverpool John Moores University and Crookes Walker
Panumart Booncharoensombut, UCL and XCO2
Tom Bull, University of Nottingham and Aecom
Zoe Dickson, Strathclyde University and SSE Energy Solutions
Helen Meutermans, University of Sheffield and AtkinsRéalis
Gareth Samson Jeyapaul, Heriot-Watt University and Egis
Laura Rashed, University of Bath and FairHeat
Klaudia Rudzionek, University of Nottingham and Arup
Ikechukwu Umeokoli, University of Warwick and AtkinsRéalis

CIBSE Apprentice of the Year 2024 shortlists

Level 3–4
Taylor McLaughlin, apprentice HVAC service and maintenance engineer, CubicWorks
Skyler Ward, MEP design engineer apprentice, Venables Associates
Lewis Devlin, apprentice design engineer, CPW
Kit Lightfoot, trainee design engineer, CPW
Kyle Curtis-Golds, building services technician, MCA Consulting Engineers
Matt Morrisons, engineering apprentice, BGIS

Level 5–7
Dan Robins, senior trainee, Aecom
Tehseen Yasin, apprentice, Arup
Daniel Wilding , MEP engineering apprentice, Black & White (B&W) Engineering
Sebastian Taylor Aguilar, building services technician, MCA Consulting Engineers
James Monk, intermediate quantity surveyor, Munro Building Services
Rosie Anderson, MEP apprentice, Aecom

CIBSE Undergraduate of the Year

Aretha Ahunanya, UCL
Jenan Kamel, University of Nottingham
Robert Lawrence, Heriot-Watt University
Karolina Prusicka, University of Sheffield
Ayah Rahmoun, Heriot-Watt University Dubai
Hasan Shwaish, University of Sheffield

Whitecode Consulting has sponsored many engineers through a degree apprenticeship

Made to engineer

Degree apprenticeships must be adopted more widely to solve the building services skills shortage, says Whitecode Consulting's Alex Hill. His tells **Alex Smith** how his firm nurtures the talent of engineers while sponsoring them through university

Alex Hill is passionate about promoting building services engineering as a career. For more than 30 years, the managing director of Whitecode Consulting, a building services company, has been visiting schools, extolling the virtues of the industry that 'will get us to net zero'.

He is most enthusiastic about degree apprenticeships where students sponsored by design engineers apply their university learning to real-world projects while receiving a salary.

Degree apprenticeships are the bedrock of Whitecode's recruitment strategy. An astonishing 60–65 employees have been sponsored by the firm through a degree apprenticeship, a feat that was recognised by judges at the 2023 Young Engineer Awards when Whitecode won the Employee of the Year award in the small company category.

Hill has a longstanding relationship with his old school – Wilmington Grammar School, Dartford – where he kept in touch with his engineering teacher Mr Booker (now retired) and went back to promote building services to students. He continues to visit, working with current engineering teacher Sarah Cross.

"If we can't find engineers, we need to make engineers"

As a result of Hill's talks, many pupils have been inspired to join Whitecode on a building services apprentice degree scheme with London South Bank University (LSBU).

'If we can't find engineers, we need to make engineers,' says Hill. 'With a skills shortage in the sector, we need people from our industry to go into schools and say: "Hi, there's something other than manufacturing that we do in engineering. Give us a chance."'

Hill is frustrated with how much attention is paid to manufacturing in schools, when the UK no longer does a lot of making. 'Schools, in my opinion, don't really cater for engineering disciplines that don't make things,' he says. 'In building services, we design a lot of things, but the components aren't made in the UK.

'I would love to say to the Education Secretary: "Take all the lathes out of your schools and instead put in a computer suite full of computers with AutoCAD and Revit installed."'

Hill says degree apprenticeships have benefits for both students and sponsoring firms. They allow Whitecode to nurture staff through their training, and the university has an active interest in how their students are progressing at work, says Hill.

'LSBU wants to make sure the students learn something here as well as at university. I think this is really key and it's not something students would get on a degree alone,' says Hill.

'The route also gives engineers a specific degree in an industry that you know you want to work in,' says Hill. 'People often say that only 15%

of a degree is used in actual daily life, but I would flip that around for the building services degree course at LSBU.'

The career route is financially beneficial for all parties, says Hill. 'Students may start working young, but they save money because they're living at home, which means they can save up enough money to move house.'

Once they finish their degree, Hill says his company is then prepared to pay them well because 'they're really worth it because they've got four years of experience'.

In presentations to pupils' parents, Hill says he shows the salary survey in the *CIBSE Journal* to illustrate his point. 'My pitch is simple: "We'll offer your child a free degree and a job for life."'

The government apprenticeship scheme only costs Whitecode £218 a year per student. 'This means we can take on as many apprentices as we want,' says Hill. 'The only limiting factor is having enough mentors in the company.'

Whitecode is keen for its students to get as much hands-on experience as possible. 'There's nothing better than going on site and seeing the consequences of your design,' says Hill. 'Having that level of input from experienced people helps engineers and BIM technicians deliver robust designs.' In the UK, Hill believes there is too much emphasis on non-vocational degrees. He says 'it drives him mad' that people do degrees in subjects they won't be using in their careers, especially given the amount of debt that builds over the length of the course.

'My father-in-law's got a degree in ancient history and he's a VAT adviser. Surely accountancy would've been a better degree?'

Hill says Whitecode will consider graduates if they have the relevant skills and demonstrate a passion for engineering in their interview but he says there are downsides.

'Graduates are older, and are going to quickly get lots of responsibilities, which means they are going to probably move around the industry, looking for that next salary increase,' says Hill.

Alex Hill discusses a student's Revit model at Wilmington Grammar School

Amy Webb

Amy Webb

Intermediate sustainability engineer

Having been inspired to start an engineering career by my grandfather, I joined six years ago as part of Whitecode's apprenticeship programme. I like to problem solve and engineering allows me to combine analytical skills with creativity to find solutions.

I went to university part-time to gain a building services degree and worked at Whitecode to develop real-life working skills. Full-time university life wasn't a match for what I wanted, which was to pursue a career as early as I could.

The company has been amazing in supporting me, and developing essential skills. Mentorship, performance reviews, and networking have helped me progress.

The exposure to real projects has allowed me to solidify my understanding at university and grow in my role as an engineer.

Whitecode offers work experience to 16-year-olds after their GCSEs and seeing their ability at that age convinces Hill they can be developed into engineers at a very young age.

'That young mind is so easy and quick to train. They're like sponges,' he says, giving an example of a boy on work experience who has built a real-life IES model in less than a week.

While interest from female engineers is still quite low, Hill says there are now more women in every job position in building services. 'The industry is a great opportunity for girls,' says Hill. 'We see a really different perspective from female engineers. Men can have quite a rigid approach and sometimes that thinking out of the box comes from female colleagues.

'It's important to get our female engineers back to our schools, championing building services and saying: "I've done this. I was you then. You could be me,"' he says.

Whitecode has ambitious plans to open more offices around the UK using the same recruitment model.

'We've just opened an office in Birmingham and I'm trying to identify A, the university course and B, the local grammar school that has an engineering teacher who might be interested in the support we can provide,' says Hill.

The next target is Manchester or Leeds and then Hill wants to see a national rollout of this strategy – but, he says, the model will need local champions for building services. ●

See p25 for the Employer of the Year 2024 shortlist

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Celebrating female engineers

At an event to mark International Women in Engineering Day, CIBSE YEN London asked those taking part to name their role models

The powerful impact that women have in the engineering community was celebrated by the CIBSE Young Engineers Network (YEN) London to mark International Women in Engineering Day.

Held at Hilson Moran's Living Lab office near London Bridge, the event served as a reminder of the incredible strides women are making in engineering, and the importance of encouraging future generations to follow in their footsteps.

The evening's highlight was a panel discussion chaired by CIBSE CEO Ruth Carter, featuring speakers Molly Behling, Erato Vasileiou, Hiba Talmoust, and Emma Taylor-Beal. Each drew on their experiences to emphasise the significance of mentorship, diversity, and community support in fostering female engineers.

Carter set the tone by reflecting on the barriers that women face, noting how essential it is for established professionals to support younger engineers as they navigate careers. Throughout the evening, attendees shared personal stories about the women who have inspired them. Here are some of them:

Molly Behling, graduate design engineer at Hilson Moran, paid tribute to Aleksandra Sasha Krstanovic FCIBSE, known for her innovative designs and leadership. Her work and lectures provided Behling with technical knowledge and confidence, solidifying her path in the field.

Waterman net zero and sustainability consultant Hiba Talmoust shared how Kellie Gerardi, an aerospace professional and advocate for space exploration, became her role model. Gerardi's dedication to making space accessible to all deeply resonated with Talmoust, sparking her passion for aerospace engineering.

Tom Bull, MEP engineer at Aecom, honoured his mother, Cindy, for the profound impact she has had on his life and career. He credited her strength, determination and unwavering support for shaping his path in engineering. Similarly, Zoe Dickson, project sales engineer at SSE Energy Solutions spoke of her mother, who 'gave up the career she loved to raise me'. This act of sacrifice resonated deeply with Dickson and shaped her determination to excel.

Director and sustainable operations client lead at JLL Erato Vasileiou drew inspiration from Mary Jackson, NASA's first black female engineer. Her courage in breaking through racial and gender barriers made her a symbol of perseverance and excellence – qualities Vasileiou has sought to emulate throughout her career.

The panel at the debate from left: Ruth Carter, Molly Behling, Erato Vasileiou, Hiba Talmoust and Emma Taylor-Beal

YEN Takeover

Mathew Stark, senior mechanical engineer at Box Twenty, remembered how his high school teacher, Mrs Neil, ignited his passion for engineering. Her encouragement and belief in his abilities played a pivotal role in his career choice.

Emma Taylor-Beal, ESG and innovation consultant at energylab, highlighted the influence of Vanessa Nakate, a Ugandan climate justice activist. Nakate's work, focusing attention on the impact of climate change on vulnerable communities, inspired Taylor-Beal to focus on sustainability and climate solutions.

Roberto R, mechanical engineer at KJ Tait, celebrated Gabriela Amaya, a member of the event's general committee, for her commitment to designing environmentally sustainable improvements to urban landscapes.

Carter cited Jennifer Cox, the past Chair of the CIBSE YEN London, for her outstanding contributions as a senior electrical engineer. Cox's dedication to her craft and her role on the CIBSE Council, combined with her awards are, said Carter, a testament to her brilliance.

Award-winning leader in sustainable urban design Clara Bagenal George was praised by Marie-Louise Schembri, Hilson Moran sustainability director, on being made an MBE, honouring her initiatives. Bagenal George's efforts to create resilient and liveable cities have inspired countless engineers. ●

Follow CIBSE YEN London on LinkedIn and Instagram @cibselondonyen

Smart thinking

Leveraging AI and data analysis, MTR Corporation has slashed energy use in two large Hong Kong properties. MTR Corporation's **Ethan Poon**, describes how the digitisation projects are setting new benchmarks for building optimisation

A major Hong Kong property developer is set to slash carbon emissions across its estate using artificial intelligence (AI) and big-data analysis, after two successful pilot projects resulted in huge energy savings and a payback of only two years.

The properties of MTR Corporation Limited (MTR) encompass 16 shopping malls, four office buildings, and more than 110,000 residential units across 57 property estates. To explore the potential of cutting carbon and greenhouse gas emissions from its estate, MTR implemented two pilot projects.

The first involved the use of a cloud-based data analytics software platform to optimise the central chiller plant at Two International Finance Centre (Two ifc), a commercial development in Hong Kong's Central District. The second looked at developing an integrated AI solution to enhance energy efficiency and customer experience at the Elements MTR Mall in West Kowloon. Both initiatives resulted in significant annual energy savings and improved building performance.

YEN Takeover

Lessons from the pilot projects can be adopted across Hong Kong

Big-data analysis at Two ifc

Built in 2003, Two ifc is a skyscraper and integrated commercial development on the waterfront of Hong Kong's Central District. Rising to a height of 415 metres, it is the second-highest structure in Hong Kong and boasts a total floor space of about two million square feet.

The pilot project involved integrating a cloud-based, big-data analytics software platform to optimise chiller plant. (Big data is described as large and diverse datasets that cannot be processed easily using traditional data-processing techniques). The initial key performance indicator (KPI) was a minimum 5% annual energy saving at the central chiller plant.

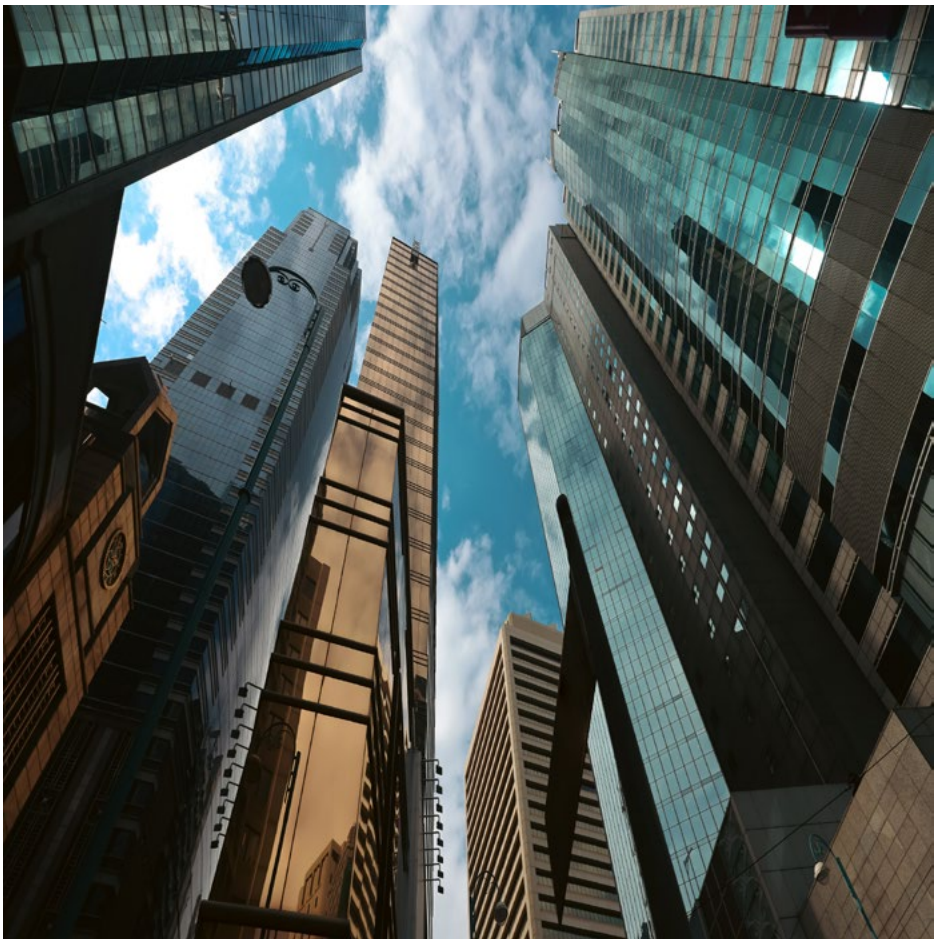
The Two ifc chilled-water system encompassed a seawater plant, circulation pumps, and chilled-water and seawater distribution networks, with a total installed plant capacity of approximately 9,800 tonnes of refrigeration (TR).

The cloud-based software platform securely collects and analyses data from ultrasonic temperature and water flow transducers, energy

AI optimisation at Two ifc

Energy-saving measures that were implemented include:

- **Aligning cooling load demand with the chiller's highest COP to maximise cooling output while minimising power consumption**
- **Optimising startup and shutdown times to reduce energy waste before occupancy hours**
- **Shifting peak cooling demands to maintain power consumption within limits**
- **Using stochastic and generalised additive models to forecast cooling load and adjust chiller settings accordingly**
- **Using FDD rules and AI models to fine-tune operational parameters of chiller equipment to ensure it stays in a predefined energy efficient range (the zero energy band).**



meters, and existing building management and energy management systems (BMS/EMS).

Real-time data is analysed to generate actionable insights aimed at enhancing energy efficiency. The platform has a secure connection to offsite storage provided by the software service provider. It incorporates fault detection and diagnostics (FDD) software that analyses hard-wired and virtual data points using time-series data. This allows for effective comparison, diagnosis, evaluation and reporting of the chilled-water system's performance.

The project team prepares monthly reports to review data analysis, insights and energy savings, allowing for continuous adjustments to the system settings. A key strategy involves optimising the operational sequence of 10 seawater-cooled chillers based on their coefficient of performance (COP), ensuring that the most efficient chiller operates first.

In terms of energy reduction, the project team maintains rigorous measurement and verification standards to comply with international and local regulations.

Historical operation data from the BMS serves as a control set for comparison before and after implementing the cloud-based platform. The system continually records trend logs and monitors performance against the energy-saving opportunities, allowing for timely adjustments to optimise energy savings (see panel, 'AI optimisation at Two ifc').

Elements MTR Mall

Opened in 2007, the Elements MTR Mall has a retail area exceeding one million square feet and accommodates more than 120 stores.

Elements undertook a proof-of-concept project aimed at developing an integrated AI solution to enhance energy efficiency and improve customer experience. The initial KPI was a minimum 3% annual energy saving at the central chiller plant.

Like Two ifc, the chilled-water system at Elements included a seawater plant, seawater and chilled-water circulation pumps, and chilled-water and seawater distribution networks. It had a total installed plant capacity of around 7,000TR.

The development of an air conditioning and mechanical ventilation optimisation model uses advanced machine learning techniques to address the dynamic characteristics of HVAC systems and fluctuating environmental conditions.

Supervised learning, where algorithms learn patterns and relationships between inputs and outputs, plays a crucial role in understanding complex, non-linear correlations.

Big-data analytics cut annual energy use by 9% at the Elements MTR shopping mall

The digital team

For the Elements and Two ifc projects, internal MTR teams work with system maintenance contractors, and technical and digital consultants.

Their responsibilities include conducting energy management assessments, identifying operational enhancements, refining logic based on operational data, and overseeing ongoing commissioning.

They also review the current physical and digital infrastructure, and establish workflows and methodologies for data processing and integrating with existing systems.

The data-processing and analysis results undergo regular reviews and assessments to gauge effectiveness and system performance.

This continuous evaluation ensures that energy saving and operational improvement measures remain optimised and aligned with desired outcomes.

Additionally, self-adaptive reinforcement learning, which involves dynamically adjusting the learning process based on feedback, means the system optimises equipment performance based on real-time energy usage and COP.

This continuous learning process enhances the model's accuracy over time, driving energy efficiency. The AI model forecasts cooling load every 30 minutes, using historical data, weather forecasts, and solar radiation.

Insights from the model guide equipment combinations and chilled-water setpoints, allowing chiller plants to proactively manage

cooling demand fluctuations and optimise energy usage. The model is improved through iterative testing and operator feedback.

Real-time data collection is vital for optimising the system based on actual demand patterns. Integrated people-counting techniques use CCTV to analyse foot traffic in different mall zones, which identifies peak usage periods.

This data informs energy-saving strategies, such as adjusting air handling unit supply temperatures while maintaining thermal comfort. More than 45 indoor air quality (IAQ) sensors monitor parameters such as CO_2 levels, temperature and humidity, enabling the AI to refine recommendations for fresh air optimisation. Compliance with local and international air quality standards, including the Reset Air Standard for airborne viral transmission, is maintained, with studies indicating excellent IAQ ratings, even during peak periods.

A data quality (DQ) assessment framework was developed to enhance AI model training. This framework identifies DQ issues and provides recommendations for the BMS. Following the assessment, a digital infrastructure upgrade plan was implemented to improve sensor accuracy and data completeness, which are essential for effective energy management analysis.

The optimisation model includes an interface visualisation platform that recommends optimal chiller configurations based on historical performance. A daily recommendation dashboard and a rule engine for real-time anomaly detection enhance predictive maintenance capabilities.

AI measures at the Two ifc commercial development cut energy use by 9% in 2023

The innovative pilot project enabled Two ifc to achieve energy savings of more than 2.3 million kWh of electricity over two years (January 2022 to December 2023), translating to a total reduction of more than 1,500 tonnes of CO_2e. The energy savings percentages stood at approximately 11% in 2022 and 9% in 2023.

At Elements, the AI system delivered an annual energy saving of around 9% during the period August 2023 to July 2024, amounting to more than 1.3 million kWh of electricity saved and a CO_2e reduction of more than 715 tonnes.

The projects have already been recognised by the industry. They have garnered four building awards that acknowledge the project teams' exceptional accomplishments in designing and operating energy-efficient structures. ●

● Ethan Poon is assistant chief project and maintenance manager at MTR Corporation

Setting up AI to optimise building performance

CIBSE technical editor Tim Dwyer on how to set up an AI model to optimise an environmental control system:

1. Define objectives

- **Establish key goals – eg, energy efficiency, cost reduction, occupant comfort, indoor air quality.**

2. Data collection

- **Gather data from sensors and control systems such as indoor/outdoor temperatures, humidity, CO_2 concentrations, occupancy, energy consumption, weather conditions, historical performance.**

3. Preprocessing the data

- **Clean and prepare the data by handling missing or inconsistent values. Perform feature engineering to extract meaningful inputs – for example, variables such as 'average occupancy during working hours'.**

4. Choose the AI model type

- **Select one to fit the system's needs:**
  - **Regression models: To predict system requirements such as heating or cooling demands based on current conditions**
  - **Reinforcement learning: To learn optimal control policies through continuous system feedback**
  - **Neural networks: To understand complex relationships between factors such as occupancy, weather and system performance.**

5. Train the AI model

- **Use historical and real-time data to predict and optimise system operations HVAC systems.**

6. Integrate with building systems

- **Connect the AI model with the BMS via IoT platforms or APIs, allowing real-time adjustments to be made.**

7. Implement feedback loops

- **Where the AI model receives real-time data and dynamically adjusts environmental controls to optimise energy efficiency and comfort.**

8. Test and validate

- **Perform simulations and pilot tests to evaluate how well the AI improves system efficiency and occupant comfort. Fine-tune the model to meet performance objectives.**

9. Continuously monitor and update

- **Monitor the system and update the AI model using new data to ensure it adapts to changing conditions.**

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Learning to fly

For those starting out in building services, the learning curve can seem daunting. **Max McCone** shares his career journey on a major airport project, and shows how experience and mentoring can send careers into the stratosphere

Entering the construction industry can be an intimidating experience. The projects move quickly, there are lots of disciplines with which to coordinate, and everyone seems to know more than you. It doesn't help that people in the industry have a tendency to speak in three-letter acronyms – AHU, RFI, BMS, and VRF, to name but a few.

As a result of these initial gaps in understanding, I see many new starters struggling to envision a career path in building services. With this in mind, I want to share my experience of moving from being a graduate trainee to mechanical engineering project lead, and offer insight into the changing roles and responsibilities that a building services engineer experiences in the first years of their career.

I credit a lot of my development to a single project – the Belfast International Airport (BIA) Terminal Extension, which involved the construction of a brand-new, modern security building and the refurbishment of existing back-of-house areas.

I joined the project team just after the scheme began in early 2022, working under principal mechanical engineer Gerry McCorry. As a graduate mechanical engineer with five months' experience, I had been involved with a variety of projects, but I had never seen a design through from inception to construction.

In that early stage of my career, I approached projects quite differently from how I do now. I tried to understand the fundamentals of construction: how does a project start; what are all the different stages; what are the dynamics of design team meetings; and how does building services fit into a larger, multidisciplinary design team? On top of that, of course, my main aim was to ensure the work was technically correct and completed on time.

Max McCone

The early stage of the BIA project taught me all the above and more. I gained fantastic exposure to designing for an aviation environment. This experience taught me to be creative with planning and phasing work, which I have applied to every project since.

I gained valuable insights into designing with sustainable technologies and practices, as the brand-new hall was served by air handling units (AHUs) and in-built reversible air source heat pumps, which provide heating, cooling and ventilation services for the hall.

To complete the sustainable package, these systems are powered by solar energy from the airport-owned photovoltaic (PV) farm located next to Belfast International.

So many of my lessons learned came from Gerry, who – with his 30-plus years in the industry – has built up a wealth of experience. He was more than happy to share his knowledge with me, and I still regularly refer to his 70-page-plus 'lessons learned' document, which has saved me more times than I'd care to say.

YEN Takeover

"Stepping into the role gave me new opportunities and... changed my priorities and thought processes"

As the project progressed, we completed the initial Stage 4 design and progressed other projects while it was being reviewed by the client – this gave me new experience to take back to BIA.

I returned to the project a few months later, during the value engineering (VE) phase, and my responsibilities had changed. I was tasked with designing systems independently and given more authority to delegate work, and found myself more focused on aspects such as fee and scope of works, as I better understood the project and the requirements of the project manager.

I found my technical knowledge had improved significantly from when I started on the project, in no small part because of a detailed CIBSE training course on ventilation design, which was kindly provided by the building services practice in Mott MacDonald.

This training gave me much more confidence in tackling the ventilation design independently and highlighted some detailed aspects that we hadn't previously considered. This allowed us to improve our design compared with the original – an ideal outcome of the VE process.

With the VE phase completed, we moved into construction and, as that transition occurred, Gerry announced his planned retirement at the end of the year. Consequently, it was decided that the logical step was for me to take over as lead mechanical designer for the project and we began carefully managing the handover process. It surprised me that the handover process was straightforward.

The Belfast International Airport Terminal Extension project taught McCone things that he has applied to every project he has worked on since

I learned that the major difficulties during handovers are usually not related to technical design elements, but to understanding the project design decisions and history. I highly recommend structuring handovers like this for managers and current graduates when making transitions – we've had fantastic results with BIA, and it gave me a strong, confident platform from which to continue my development.

Stepping into the role gave me a whole new set of opportunities, specifically around engaging directly with clients. It also gave me a much deeper, more practical understanding of contracts and the legalities associated with projects, and how they guide our work processes. It also changed my priorities and thought processes when I work.

Previously, I'd jump right in, wanting to complete things as quickly as possible. Now, I take a much more balanced approach and consider a number of factors, such as: the fee available; the deliverable we need to produce; the best fit for resource considering the deliverable; the timescale we have to deliver it; what we need from other disciplines; and what we did previously – and the lessons learned.

Coming full circle, I also consider how to teach the more junior members of the team about the best way to approach the problem.

I have found the transition from graduate to project lead to be a really fulfilling experience, and I've completely altered my approach to work and how I view the industry as a whole – although I still think there's far too many three-letter acronyms!

The one piece of advice I could pass on to those entering the industry is 'don't underestimate yourself'. I constantly worried about whether I'd be able to handle increased responsibility or whether I'd be exposed as some sort of imposter.

It turns out you usually know more than you think, and most people are more than happy to teach you, or give advice on anything you don't know – they have all been in your shoes at some point!

Any current or incoming graduates who want some advice on managing their changing roles, or even just a chat about progression, please reach out to me on LinkedIn – I'm more than happy to offer any guidance I can. ●

Max McCone is a mechanical building services engineer at Mott MacDonald, and global vice-chair of CIBSE YEN

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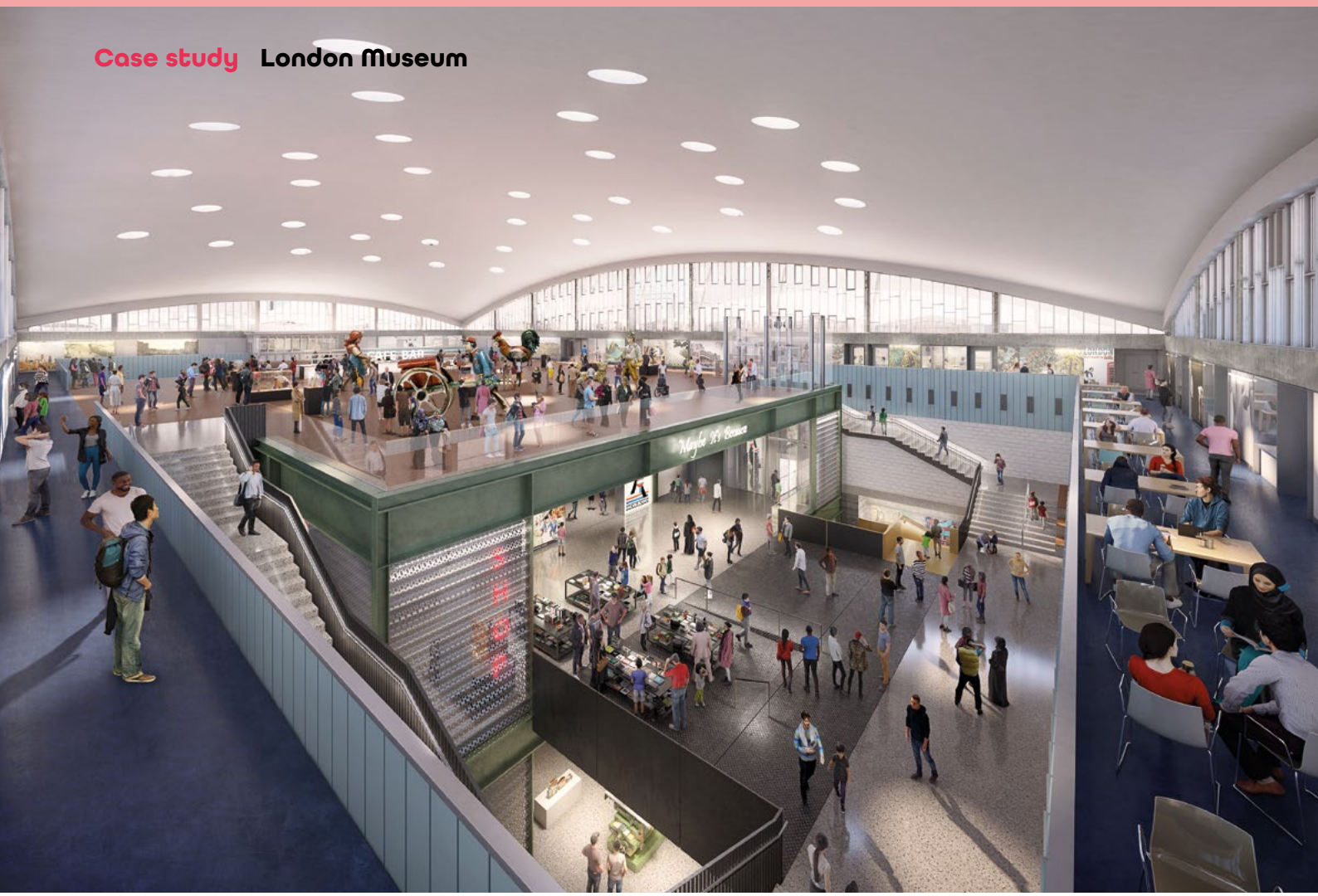
History in the remaking

The services challenge of transforming Smithfield Market into a smart new home for The London Museum



The museum of tomorrow

The London Museum's relocation to Smithfield Market is an ambitious £437m project to transform a series of abandoned market buildings into a state-of-the-art cultural destination. **Andy Pearson** looks at how Arup's smart services strategy will ensure energy use is 70% lower than Building Regulations

'The world's greatest city deserves the world's greatest museum.' So said London's mayor Sadiq Khan in 2017, announcing the GLA's £70m contribution to the £437m project that will transform parts of Smithfield's historic market into a new home for The London Museum.

This ambitious project will see the dilapidated General Market building, which dates back to the Victorian era, and the domed Poultry Market building, built in the 1960s, both being brought back into use with the addition of contemporary interventions, to create exciting and flexible exhibition spaces.

The servicing and sustainability strategy for these two historic buildings that will form the heart of the world's greatest museum has been developed by Arup. Working with lead architect Stanton Williams, together with Asif Khan and conservation architect Julian Harrap, the engineer has devised a building services solution sympathetic to the heritage buildings without compromising visitor comfort.

Operational performance of building services will be further enhanced by a smart building strategy where every item of plant and equipment is data-enabled to optimise the running of the museum and minimise its carbon emissions.

Fundamental to developing an energy efficient services solution was the thermal performance of the buildings' historic façades. At the project's outset, the teams worked to enhance the thermal performance of the existing envelope by adding insulation and double glazing where possible. Fritting was also applied to some glazing elements to help control solar gains.

Beneath this historic envelope will be the museum's 8,000m^2 of permanent gallery spaces and 1,500m^2 of temporary exhibition spaces, alongside extensive storage, research and education areas.

Arup's servicing strategy has been to work with the fabric of the buildings to help deliver the environment needed for the various spaces with the minimum amount of energy.

'We were fortunate with these buildings because their former purpose was to keep products fresh while allowing traders access; this overlaps with the museum's requirement to preserve artefacts and provide entry for

"Credit to the museum, it accepted a much wider temperature and humidity band for most spaces than is the norm in the arts and culture world"

Vasilis Maroulas, Arup

visitors,' says Vasilis Maroulas, associate director at Arup and lead mechanical engineer on the project.

Central to this approach is the distribution of the various spaces and galleries. Arup developed a solution based on positioning galleries and spaces where environmental conditions were most critical at the core of the buildings. The temporary galleries, to host loaned exhibitions, is the space with the tightest environmental conditions: it's on the ground floor at the centre of the Poultry Market, sandwiched between the basement art storage and the multifunctional space on the first floor. 'It is effectively a box within a box, completely protected from solar gains,' explains Maroulas.

The HVAC system used to serve the temporary galleries is an all-air centralised ventilation system with high-level supply and extract to provide mixed and uniform conditions within the entire volume of the galleries.

For the remainder of the spaces, Maroulas says Arup has adopted 'an adaptive comfort approach' to the servicing. 'Credit to the museum, it accepted a much wider temperature and humidity band for most spaces than is the norm in the arts and culture world, which helped us immensely,' says Maroulas.

Beneath the temporary galleries, the former basement cold stores are currently being transformed into a store for the museum's seven-million-strong collection. The store includes a publicly accessible space, where visitors will be able to glimpse the collection. This area is served by a mechanical ventilation system with air conditioning from high level supply and extract terminals. 'This is a low air volume air conditioning system, with minimal operational energy, because this is a collection store and the lights will be off for most of the time,' Maroulas explains.

The space above the temporary galleries is open to the building's dramatic, domed reinforced concrete roof – once the largest single-span concrete roof in Europe. This space will be for a wide variety of uses, from exhibitions to evening events, lectures, receptions and so on.

Here, Arup is looking to exploit the thermal mass in the roof combined with a natural ventilation solution. Maroulas says: 'We have adopted the simple strategy of opening the lunettes windows at high level to help create air movement during the day.'

In winter, the space is heated by an underfloor system using pipes concealed in the new floor slab. This is designed to keep the space at a temperate 18°C – 20°C during occupied hours. On hot summer days, the exposed thermal mass of the giant domed roof will be supplemented by cooling the floor slab. 'Rather than introduce a cooling system, we decided to run cool water through the underfloor pipes to activate the floor's thermal mass to take out the temperature peaks,' explains Maroulas.

The museum's main entrance is off the canopied West Poultry Avenue, the covered street that runs between the two buildings. The entrance channels visitors on to the ground floor of the General Market building. This floor is intended to be the museum's sociable space, complete with restaurant, bookshop and galleries, which are all open to the glazed roof with its central dome. This space, too, is naturally ventilated throughout the year, supplemented with underfloor heating.

An additional challenge is that the large, naturally ventilated spaces in the General Market ground floor had to be able to host evening events, including formal dinners. For these events, air is brought into the space through attenuated low-level openings to keep external/outside noise to a minimum while rooftop fans will assist air movement through the space.

Beneath the bustle of the ground-floor entrance is the space for the permanent galleries. These contain the majority of the museum's exhibits housed within the high brick-vaulted basement and the previous Salt Store

spaces, parts of which were only discovered once restoration was under way. In these subterranean galleries, the museum's curators were prepared to accept temperatures of between 16°C–24°C.

Two different methods are used to supply conditioned air to the 30m-wide, labyrinthine space. For the entrance area, which is open to the floor above, a high-level mixing system supplied from either side, is used to provide a buffer at the entrance to the galleries. Beyond this, the rear two-thirds of the space is supplied with air from an extensive network of floor trenches, using a displacement system. 'Our mechanical engineers had to work with the exhibition design team and our CFD building physicists to develop physical mock-ups to reach a compromise solution that would allow sufficient air movement to create uniform conditions within that space,' explains Maroulas.

In Victorian times, deliveries arrived by rail to this level. The tracks are now used for Thameslink trains, which themselves will become a moving exhibit, viewed through a window in the basement wall.

Heating and cooling for both buildings is being provided by E.ON's Farringdon energy centre – see 'Greening the City', April 2022 *CIBSE Journal*.

This ambitious project had originally targeted Breeam Excellent: it is currently on target to achieve Breeam Outstanding.

What's more, Maroulas says by being lean with the design and using passive techniques, the current estimate is that the museum's energy consumption will be 70% lower than that of a baseline building representing the proposed end use. This calculation includes the existing building fabric and assumes the building services systems is compliant with the latest Part L minimum requirements.

The General Market building is due to open in 2026, and the Poultry Market building two years later.

Already, there is a presumption that the scheme might actually achieve the targeted levels of energy consumption predicted using CIBSE TM54 as it has the added benefit of smart-enabled building services (See panel 'Connected curiosities').

When it opens, it is expected the building can be tuned to get the energy use down to the predicted figure, and the smart data means it will be much easier to know what to tweak to get energy to those levels. ●

Connected curiosities

The London Museum had aspirations for its new building services to be 'smart' to enable it to maintain and operate plant efficiently.

Steve Watson from the London Museum has driven the smart agenda. 'Steve was focused on the operational performance of the building services systems in order to get the building to speak to the FM team so that they can get ahead of any problems,' says Adam Jaworski, a smart buildings consultant at Arup.

A major challenge for a building with smart services is enabling the different systems to talk to each other. Arup's starting point has been to ensure consistent naming of every single item of building services equipment, including individual light fittings and fan coil units, by allocating each a unique code. Arup developed a naming code protocol based on the Building Device Naming Standards by the Open Data Institute. This ensures that device and asset names and codes are consistent whenever a device appears on a CAD drawing, in a BIM model, in control software, in asset management systems and asset databases.

Jaworski says many devices, such as light fittings and inverter drives on motors and fans, already have all the telemetry built in.

'The key thing we are doing with this building is to bring the data from heterogeneous systems back to one internet-enabled intermediary device called an IoT broker. The IoT broker receives device data as JSON files – text files that both humans and machines can read. Once the data is standardised, it can be combined with data from other sources such as a construction BIM model that uses exactly the same device tags.'

The data will enable workflows such as performance analysis and computer-aided facility management.

'When people ask what a smart building is, I say it's about getting things online,' says Jaworski.

On site, construction manager Sir Robert McAlpine is using One Sightsolutions as a smart building contractor. As master systems integrator, it is responsible for aligning the trade contractors' digital delivery. 'They are policing devices; they are making sure that the things that are going on the smart building side are in the correct format,' explains Jaworski.

Working with fans

A study monitoring CO_2 in food and drink kiosks at major venues revealed the poor air quality in busy periods. A summary of work by UCL's **Filipa Adzic** highlights the importance of flexible ventilation strategies

The Covid-19 pandemic caused disruption to live events, with the sports and entertainment industries being particularly hard hit during the lockdowns.

To help the UK safely lift restrictions on large gatherings, the government initiated the Events Research Programme (ERP). One key area of focus was identifying risks associated with event venues, particularly focusing on ventilation in high-traffic areas, to better understand how indoor air quality (IAQ) might influence the spread of airborne viruses such as SARS-CoV-2.

The results of the study were presented at the CIBSE Technical Symposium in Cardiff earlier this year.

A significant portion focused on monitoring air quality in food and drink concession stands because they often experience transient, yet high occupancy. CO_2 monitoring was used to assess ventilation performance, as elevated CO_2 levels serve as a proxy for poor ventilation and potentially higher concentrations of exhaled breath.

The study used non-dispersive infrared CO_2 sensors capable of measuring concentrations up to 5,000ppm with an accuracy of 30ppm. Loggers were installed at breathing height (1.6m to 2.3m) to provide high-resolution data.

Ventilation was monitored at 10 venues in England, covering 179 spaces over 90 events. These venues included a range of indoor spaces, from seating areas and concourses to toilets, restaurants, private boxes, and food and drink concession stands.

The research team recorded CO_2, temperature and relative humidity levels, noting times of high occupancy and verifying this data with CCTV footage. The research was observational, with the team present during most events but refraining from intervening in venue management.

CIBSE Guide A recommends a provision of 10 l/s per person of outdoor air in spaces like concession stands, but post-occupancy evaluations are rare. To assess whether ventilation strategies are adequate during peak occupancy, CO_2 levels were closely monitored in concession stands at Royal Ascot, Wembley Stadium, and the O2 Arena.

At Royal Ascot, a single bar was monitored over five events with an 18% occupancy (12,600 attendees). Similarly, 16 bars and kiosks were monitored at Wembley Stadium during Euro 2020 football matches, with occupancies ranging from 3% to full capacity (90,000). Lastly, four bars were observed at the O2 Arena during a music awards ceremony with 18% occupancy (3,532).

Air-quality classification bands were developed to rapidly assess ventilation effectiveness and the associated risk of airborne virus transmission. The bands, ranging from A to G, classified spaces based on average and maximum CO_2 concentrations, with 'A' indicating good ventilation and 'F' or 'G' suggesting ventilation improvements were needed.

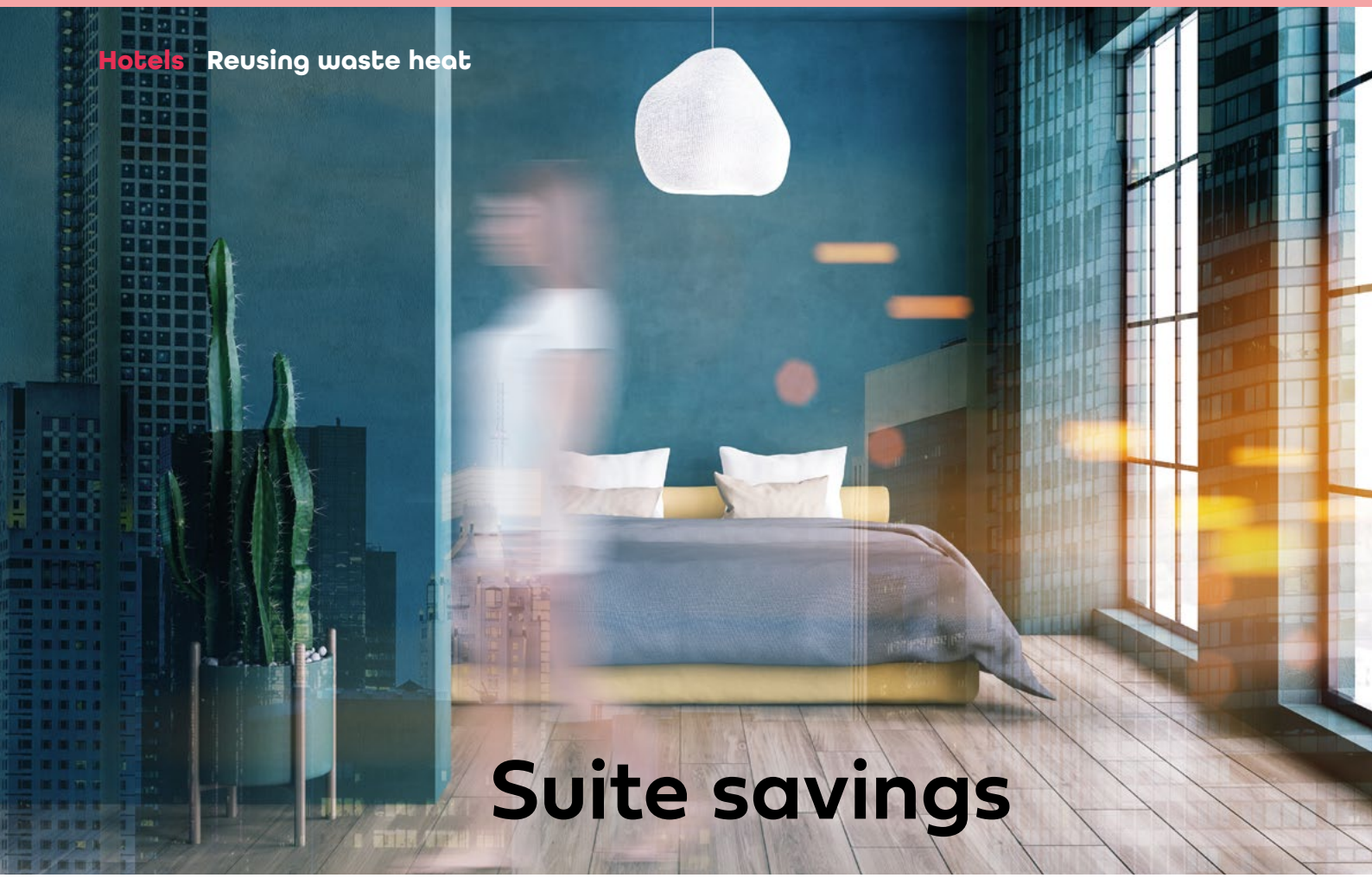
Results showed that 86% of kiosks had good ventilation when considering the average CO_2 levels at the event, which included high and low-occupancy periods. However, at maximum CO_2 levels during peak occupancy, only 45% of kiosks maintained good ventilation, while 12% were in F and G bands, indicating ventilation could not cope.

One outcome was the influence of event management and structure on ventilation performance. For example, the O2 Arena and Royal Ascot had more frequent breaks, which allowed for a more even distribution of people in concession stands, resulting in relatively flat CO_2 levels. However, Wembley, where fans are not permitted to take drinks into the seating areas, saw significant spikes in CO_2 before the match and during half-time, reflecting higher concentrations of people.

Here, the research also showed that ventilation strategies differed across levels. Level 1 and 2 concourses, which are naturally ventilated, maintained CO_2 concentrations below 1,500ppm even at full capacity. But level 5, with natural and mechanical ventilation, experienced higher concentrations at occupancies above 72%, suggesting ventilation was insufficient for peak demand.

This has important implications for event management and building design. Ensuring sufficient ventilation in high-occupancy areas is critical. Organisers and venue designers should consider the layout and structure of events when planning ventilation strategies. It's vital that solutions can adapt to occupancy levels and event structures. ●

● **Filipa Adzic, is a research associate in fluid mechanics at UCL**



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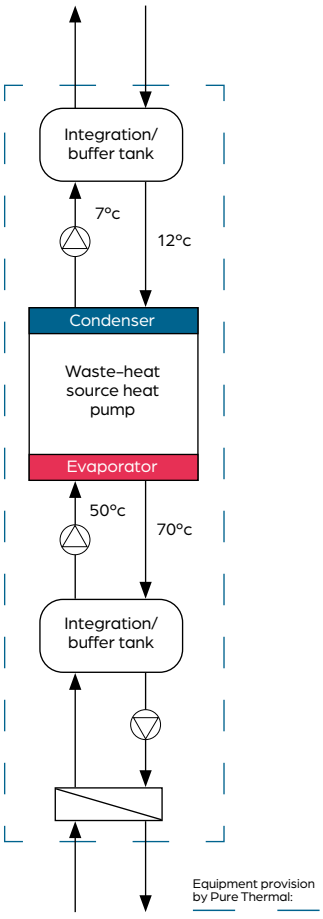

Figure 1: Single source (chilled water return only) waste-heat source heat pump delivering to the secondary hot-water return

Hotels ask guests to reuse towels to save energy, but installing waste-water heat pumps to reuse heat would have a much bigger impact, reports **Andy Pearson**

In hundreds of hotels across the country heat from cooling systems is being rejected at the same time as fossil fuel is being burnt to heat domestic hot water.

Throwing away valuable waste heat at the same time as the boilers are in operation is deplorable, says Garry Broadbent, operation director and founder of Pure Thermal, given the increasing cost of energy and the urgent need to cut carbon emissions.

It is unfortunate because, he says, large hotels offer an ideal opportunity to recycle heat that is being wasted and they also have a continuous demand for domestic hot water.

In a typical hotel, Broadbent says, heat is rejected from three main systems: food service refrigeration; data room; and air conditioning.

The merit of these loads is that they are predominantly independent of outside ambient temperature, so the quantity of heat rejected by the packaged chillers serving the hotel's main chilled-water circuits will be available 52 weeks a year.

In addition to the chillers, the boilers will run continuously year-round to provide heat for the domestic hot-water services. 'If you imagine a large hotel, the secondary return on the domestic hot-water circuit will circulate continually, which could result in up to 60kW of heat lost from the system that will require replenishment,' Broadbent says.

The solution developed by Pure Thermal links the two systems with a waste-heat source heat pump. The heat pump can be connected to the return legs of a chilled-water circuit, cooling tower and condenser circuit where valuable waste heat is being rejected. Generally, the temperature of the return leg of a chilled-water circuit will be between 12°C–14°C depending on system criteria.

Using the waste heat recycling system, Pure Thermal's system takes the heat from the chilled-water return that would otherwise have been

"The opportunity to recycle wasted heat at a micro level should not be overlooked, because it represents a major cost and carbon reduction opportunity"

rejected, and uses this recycled waste heat to raise the temperature of the return leg of the domestic hot-water circuit up to 70°C.

The benefit of this solution is that absorbing heat from the chilled-water return reduces its temperature to 7°C or 8°C, which means the chiller no longer needs to run, saving chiller input power. Similarly, because the domestic hot-water return is being heated by the waste-heat recycling system, using heat that would otherwise have been rejected – means the boiler is not consuming gas.

What's more, because demand for cooling and hot water are year-round, these carbon and energy savings will also be year-round.

As the waste-heat source heat pump is cooling and heating simultaneously, the solution is similar in operation to using a 4-pipe chiller but, Broadbent says, this system is 'very flexible and is able to work at a high temperature'. The heat pump is manufactured by Oilon as part of its ChillHeat range, which has been designed specifically to produce hot water at temperatures of up to 120°C from low-grade waste heat.

In addition to the heat pump, the system will usually include a hot-water storage tank, which acts like a thermal battery and gives the heat pump a working volume. 'The tank allows us to make hot water when waste heat is available, but at times when there is little or no demand for hot water,' says Broadbent. And, while the system would connect directly to the chilled water circuit, a heat exchanger is usually required for the interface with the domestic hot-water return.

In Figure 1, a Pure Thermal single source heat pump, with low GWP refrigerant R1234ze, delivers a total thermal output (heating and cooling) of 176kW with an input power of 35kW. This gives a TER of 5.03 or 503% efficiency at a temperature of 70°C.

However, this TER does not yet account for the existing chiller's input power that would be displaced by using the waste-heat source heat pump because the heat pump is providing cooling. Assuming an average SEER of 4 for a chiller and deducting its input power from the heat pump, the adjusted actual TER of the heat pump now becomes 10.2.

Broadbent says the system could also be used to take heat from a general ventilation extract, say from a hotel swimming pool, which might be at a constant 15°C. However, the downside of using a ventilation extract is that there is no efficiency benefits to cooling the air compared with a chilled-water circuit where absorbing heat displaces chiller input power.

Since this is designed as a retrofit system, the cost and carbon case for its application can be made relatively easily based on historical data. Using metered and BMS data should enable a comparison between the amount of heat that could be recovered with the amount of heat required for water heating. This will ensure the system is configured to deliver maximum payback.

If the data is not available, Pure Thermal can provide a survey service that includes fitting metering equipment temporarily to record required and rejected heat to help establish the viability for a retrofit waste-heat source heat pump.

Broadbent is frustrated that more opportunities to reuse waste heat are not being pursued because they are 'outside the main carbon reduction agenda'. It is a problem made worse, he says, because, historically, the specification of heating and hot-water systems in hotels was separate from the specification of air conditioning and refrigeration equipment.

While he acknowledges that this system is unlikely to be applicable to new all-electric hotels, Broadbent says there are still plenty of legacy large hotels where this technology could be successfully applied. 'What are constantly overlooked are those applications that, by design, are producing heat that goes to waste,' he says.

'As an industry, we need to take a step back from the multi-megawatt replacement of boilers with heat pumps to save carbon and also tackle areas where there are easy gains to be had.'

While he admits that often the quantity of heat wasted might be relatively small – say 50kW or 100kW from a 2MW chiller – he says the opportunity to recycle wasted heat at a micro level should not be overlooked because it represents a major cost and carbon reduction opportunity.

'When an end user understands that they are wasting costly heat energy and emitting carbon unnecessarily they immediately become interested in the possibility of heat recycling.' ●

Hotel systems that generate waste heat

- **Food service refrigeration: this might comprise a suite of cold rooms in the basement including freezers, chillers, and a chocolate preparation room, which together might be rejecting up to 70kW of heat**
- **Data rooms: where up to 70kW of heat might be rejected from servers and IT systems controlling hotel operations**
- **Air conditioning systems: providing cooling to common areas, atria, gyms, basement spaces, guest rooms, and so on.**

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Safe application of modern refrigerants in RACHP systems

This module explores the factors that determine flammability categorisation of refrigerants and key standards for safe low-flammability refrigerant applications

The growing focus on environmental sustainability has driven the refrigeration, air conditioning and heat pump (RACHP) industry towards adopting refrigerants with lower global warming potential (GWP). The new applications of refrigerants, while beneficial for the environment, often come with new risk considerations compared with traditional choices. While traditional refrigerants are considered non-flammable (although most of them can burn under certain circumstances), some modern options are classed as flammable. This necessitates stricter safety protocols throughout the entire life-cycle of the RACHP system, from selection and installation to maintenance and disposal.

The presentation by Takizawa[1] provides a useful overview of the properties that impact refrigerant flammability, which include the limits for upper and lower concentrations in air (upper flammability limit (UFL) and lower flammability limit (LFL)); the burning velocity (higher burning velocity signifies a faster burning rate, translating to a faster spread of fire); the minimum ignition energy (MIE) (higher means more difficult to ignite); the quenching distance (the closest a flame can get to a cool surface, such as a metal cabinet, before it goes out); and the flame extinction diameter (which helps explain how heat loss and flame size influence flame stability).

According to the 2020 paper[2] that followed on from an ASHRAE and AHRI-funded research project involving extensive laboratory testing of A2L refrigerants, it was discovered that when the refrigerant concentration was increased slowly, open flames from candles, matches and cigarette lighters extinguished rather than initiated significant explosions (deflagrations). (The study excluded lubricating oil and high humidity effects on ignition, and did not account for open flames from gas hobs or room heaters.)

However, a still mixture of refrigerant and air (known as a 'quiescent premixture') above the LFL can ignite when exposed to very hot (740°C) elements (compared with a cooker element at 480°C) and open flames (matches and butane). This highlights the need for appropriate ventilation for spaces with A2L refrigerants to ensure that the LFL is never reached. The researchers discovered that other sources likely to be found in occupied premises did not ignite the A2L refrigerant even when in a quiescent premixture. These included a smouldering cigarette, a butane lighter, friction sparks, a mains plug and socket, a light switch, a bread toaster, a hair dryer, a hot plate, and a space heater. The difficulty in igniting an A2L in air is partly attributable to its relatively long quenching distance of approximately 8–25mm that compares with propane at approximately 1.5mm. Additionally, the minimum ignition energy for a typical A2L is 10J, compared with approximately 0.0003J for methane[3] and propane. Under some conditions, the tested A2L refrigerants were observed to act as flame suppressants. (There are interesting videos linked from the paper[2] that illustrate the test results.)

Several standards influence the application of refrigerants that have their origins in standards organisations, such as the International Standards Organisation (ISO), the International Electrotechnical Commission (IEC), the European Committee for Standardisation (CEN), and the American National Standards Institute (ANSI). Although some standards are considered global, they are frequently adopted by national, regional, and local standards authorities, sometimes with local deviations. Also, since the development timeline for standards is not common, they do not necessarily agree on specific guidance at any one time. Standards are informally referred to as 'vertical' when applying to a specific industry or group of products and 'horizontal' when they are referenced by a wide range of industries. Horizontal standards will, for example, likely account for the requirements of a wide range of system types during the design, installation, commissioning, servicing and end-of-life processes.

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BS ISO 817:2014[4] establishes a system for assigning the safety classification commonly used for refrigerants based on toxicity and flammability data, and provides a means of determining refrigerant concentration limits. The classifications – shown in Table 1 – are synchronised with those of ANSI/ASHRAE Standard 34 *Designation and Safety Classification of Refrigerants*.

Ensuring a safe system may be by 'intrinsic safety' and 'extrinsic safety' methods. Intrinsic safety limits the quantity of refrigerant so that any leaks into the space cannot create an unsafe condition. Extrinsic safety employs alternative measures – such as the physical arrangement of the system, additional safety equipment, and operational procedures – to ensure that a dangerous situation cannot arise. Some equipment, such as refrigerant gas detectors and alarms, may be included as part of the product and some sourced separately and installed on site.

The horizontal standard BS EN 378 *Refrigerating systems and heat pumps – Safety and environmental requirements* (which is currently under review) is intended to minimise possible hazards to persons, property and the environment across the whole array of refrigerating systems and refrigerants. It effectively acts as a foundation for risk management, establishes safety benchmarks, and promotes best practices for working with refrigerants in systems that cover many product groups. This standard engages with the work of the various building engineering professionals when working on UK and European projects. (ISO 5149[5] may be more appropriate for work outside that geographic area.)

The vertical standard BS IEC EN 60335-2 *Household and similar electrical appliances – Safety* focuses on the specific safety requirements for the appliances (or products) themselves. (Despite its title, this standard relates to commercial applications.) The recent 2023 revision to BS EN IEC 60335-2-40,[6] which specifically covers electrical heat pumps, air conditioning and dehumidifiers, included many revisions relating to the safe application of A2L refrigerants. It provides manufacturers with a clear and concise set of guidelines to follow, ensuring that their products are safe, reliable, and efficient.

In the UK, all refrigerants are subject to Dangerous Substances and Explosive Atmosphere Regulations[7] (DSEAR). Identified risks must be eliminated or minimised as far as reasonably practicable. Conducting and documenting relevant risk assessments is essential, along with ensuring the proper provision of safety equipment such as leak detection, ventilation, shut-off valves and alarms.

As highlighted by the Federation of Environmental Trade Associations[8] (FETA) in the Pressure Equipment (Safety) Regulation (PE(S)R), A2L refrigerants are classified as 'dangerous' owing to their flammability. Split air-conditioning systems using A1 refrigerants are more likely to be in PE(S)R Category 1 (or possibly exempt and therefore only required to be constructed in accordance with 'sound engineering practice' (SEP)). For these systems, the contractor can self-certify its compliance with the regulations. In contrast, systems with A2L and A3 refrigerants are more likely to be in Category 2 or above, and so will require some form of assessment by an Approved Body before a UK Conformity Assessed (UKCA) mark can be applied to the installed system. This body must verify the design and technical information and witness a portion of the strength pressure tests. The Cool Concerns briefing note[9] advises that the contractor acts as the 'manufacturer' of the complete system and is usually responsible for the final conformity assessment (see IoR Guidance Note 36[10] for more detail).

One of many ways that manufacturers can achieve a UKCA (or CE) mark is by demonstrating conformity to the requirements of a harmonised safety standards, such as relevant parts of BS EN IEC 60335. BS EN 378-1 notes that product family standards dealing with the safety of refrigerating systems take precedence over horizontal standards covering the same subject, including limits on refrigerant quantities for a particular application. BS EN 378 applies to a far wider, generic set of applications that are outside the scope of individual product standards.

One of the key issues of employing A2L refrigerants in room units, such as would be used in split air conditioning and variable refrigerant flow (VRF) systems, is the allowable charge of refrigerant in a particular space. Fortunately, recent editions of BS EN 378-1 and BS EN IEC 60335-2 are generally consistent on refrigerant quantity limits if the same assumptions are

	Lower toxicity	Higher toxicity
Higher flammability	A3	B3
Flammable	A2	B2
Lower flammability	A2L	B2L
No flame propagation	A1	B1

Table 1: Safety groups for refrigerants, as described by BS ISO 817:2014

applied to both standards. However, in specific applications, there may be different areas of nuance in the horizontal and vertical standards, and the standards should be consulted for full details.

Both current versions of BS EN 378–1 (equation C.2) and BS EN 60335–2–40 (equation GG.9) use the same (empirical) intrinsic safety equation to establish the minimum room floor area A_{min} (m^2) that can be used to install an appliance with refrigerant charge m_c (kg) where the room is unventilated, $A_{min} = (m_c / 2.5 \times LFL^{1.25} \times h_0)^2$ where:

h_0 is assumed release height of leaking refrigerant, greater of (h_{inst}+h_{rel}) or 0.6m

h_{rel} is distance (m) from bottom of appliance to point of release

h_{inst} is the reference installed height of the unit (0m for floor–mounted, 1.8m for wall–mounted, and 2.2m for ceiling–mounted)

For example, applying a floor–mounted room unit, such as that shown in Figure 1, charged with 2.4kg R32 (an A2L refrigerant) that has an LFL of 0.307kg·m^{-3},the minimum allowable room area for the room unit where there is no ventilation would be $(2.4/(2.5 \times 0.307^{1.25} \times 0.6))^2 = 49.02m^2$ in unventilated areas.

However, when a fan that is incorporated into the unit is either continuously operated, or through an appropriate refrigerant detection system, is able to deliver a sufficient recirculation airflow rate (of at least 30 x m_c/LFLm^3·h^{-1}, according BS EN 60335–2–40), the allowable minimum room area can be smaller, as it is assumed that the recirculation will prevent potentially leaking refrigerant reaching the LFL, while alarms will also alert users to the leak. BS EN 378 and BS EN 60335–2–40 suggest that leak detectors should be located where leaking refrigerant may stagnate or concentrate, but they (currently) differ in specific detail. However, the intent is the same in the two standards and, although using different calculation methods, they appear consistent (and the upcoming revisions to BS EN 378 may provide increased similarity in method).

From BS EN 60335–2–40 equation GG.11, the simplified empirical relationship is $A_{min} = m_c/(0.75 \times LFL \times h_{ra})$ where h_{ra} is the estimated reaching height of the airflow (m). So, repeating the previous example for a floor–mounted unit with 2.4kg R32, and an estimated reaching height of 0.6m, the minimum room area = $2.4/(0.75 \times 0.307 \times 0.6) = 17.4m^2$ for the unit with a circulation fan and an inbuilt leak detector. This provides opportunity for applying the unit in a smaller room by applying extrinsic safety measures where, in the event of a leak, the indoor unit must be capable of increasing the fan speed to maximum and triggering an alarm. (The installation could also comply with BS EN 378–3[11] if the system leakage alarm has an independent power source, such as a battery–backed supply.)

Figure 1: An example of a floor–mounted room unit, charged with 2.4kg R32, capable of delivering up to 5kW sensible cooling and 6kW heating (Source: Mitsubishi Electric)

In the calculations undertaken above, a key variable is the mounting height of the unit – this should be considered carefully to ensure that the minimum areas are properly representative of an installation. A site variation to the mounting height can significantly impact the installed system, as it determines the extent to which refrigerant, if it leaks out of the system, will disperse through the whole space rather than pooling in a concentrated layer at floor level.

Meeting the requirements of the comprehensive product safety standard may well be considered as appropriate for compliance regardless of the horizontal standard. Indeed, the introductory text to BS EN IEC 60335–2–40:2023 explains there is no need to refer to horizontal standards for products within its scope, since they have been taken into consideration when developing the general and particular requirements of this vertical standard.

As with any engineering solution, manufacturers, installers and operators have a responsibility to ensure that installations meet the safety levels established by industry standards. It is crucial to understand how to evaluate and mitigate risks associated with the use of refrigerants, and the systems that incorporate them. To help address concerns such as refrigerant leakage and detection, while providing flexible heating and cooling solutions, manufacturers have introduced hybrid VRF systems. These systems place all refrigerant–containing components outside of commonly–occupied spaces and use water for heat distribution, thereby minimising both leakage risks and the amount of refrigerant required.

In all cases, the designer should have a clear understanding of why decisions are made and apply the standards that are most appropriate to the application. ●

Module 237

October 2024

1. What is the primary factor driving the new applications of refrigerants?

- ☐ A Enhanced system lifespan
- ☐ B Growing focus on environmental sustainability
- ☐ C Improved energy efficiency
- ☐ D Reduced manufacturing costs
- ☐ E Reduce the need for refrigeration technician training

2. What is the typical minimum ignition energy for an A2L refrigerant, compared with approximately 0.0003J for methane?

- ☐ A 0.001J
- ☐ B 0.01J
- ☐ C 0.1J
- ☐ D 1J
- ☐ E 10J

3. Which of the following factors is NOT included in the equation to determine the minimum room floor area for installing an RACHP appliance containing refrigerant?

- ☐ A Assumed release height of leaking refrigerant
- ☐ B Lower flammability limit
- ☐ C Refrigerant's burning velocity
- ☐ D Refrigerant charge
- ☐ E Room height

4. What type of safety method limits the quantity of refrigerant to prevent unsafe conditions in case of leaks?

- ☐ A Active safety
- ☐ B Extrinsic safety
- ☐ C Intrinsic safety
- ☐ D Passive safety
- ☐ E Regulation safety

5. How do hybrid VRF systems enhance safety in applications concerned about refrigerant leakage?

- ☐ A By employing smaller refrigerant charges than traditional systems
- ☐ B By incorporating advanced sensors that can detect leaks at much lower concentrations
- ☐ C By locating refrigerant components outside occupied spaces and using water for heat distribution
- ☐ D By using a hybrid (or mixed) refrigerant that is less flammable
- ☐ E By utilising a novel warning system that is controlled by AI

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See water differently

Green solutions must play a key role in managing rainwater, experts conclude in a Wavin white paper

Improving how we manage water in urban landscapes is now more pressing than ever, warns a new white paper from surface-water management specialist Wavin.

The report outlines Wavin's recommendations for future-proofing infrastructure following an event it staged titled 'See Water Differently' in April. The event brought together industry experts to discuss fresh perspectives on water's pivotal role in urban climate resilience (UCR) with increasing environmental pressures.

The core message of Wavin's white paper is clear, to future-proof urban infrastructure, cities must embrace a more sustainable approach to water management, including sustainable drainage systems (SuDS). Several practical recommendations are outlined, aiming to provide a clear roadmap to slow or remove the flow of water in traditional (grey) infrastructure systems.

Building services engineers will play a pivotal role in adopting and implementing these solutions.

One of the key takeaways of the report is the need for a hybrid approach to water management. The idea is to start with environmental (blue/green) objectives, which are then complemented with grey infrastructure, such as underground drainage pipes, to enhance overall system reliance.

'Green solutions should play an important role in managing our everyday rainfall and can really complement grey systems by accommodating some of the pressures created by the climate, growing populations, and an ageing asset base,' said Dr James Webber, lecturer in Water Systems Engineering at the University of Exeter, during the panel discussion.

The consensus was that designs should be green by default as the

Intelligent park drainage

In a UK first, Wavin fitted a central London park with its, modular QBic Plus stormwater management system. This gathers and stores stormwater from across the entire site using OsmaDrain pipes and then releases it at a controlled rate via ground infiltration and attenuation tanks connected to the local drainage system. The result is an attractive urban park that always stays dry while taking the pressure off nearby sewers. The system is easy to maintain and can be tailored to a range of sites.

starting point for any water-management project.

SuDS systems are designed to mimic natural processes by slowing and capturing stormwater to prevent it from overwhelming sewer systems. They include rain gardens, green roofs, tree pits, and permeable paving.

In cities like London, where the population continues to grow and infrastructure ages, SuDS are becoming increasingly critical. London's sewerage system, which is 150 years old and was built for a population half the size of today's, is struggling to cope. Research by Thames Water reveals that the number of homes at risk of internal sewer flooding in the city is expected to rise by 54% between 2025 and 2050.

In response to this challenge, Thames Water has adopted a 'SuDS first' approach, which prioritises sustainable drainage solutions to help manage surface water. (See panel 'Intelligent park drainage' for examples of how this can be achieved)

While building new SuDS is essential, the report stresses that retrofitting these systems into dense urban areas is equally vital. However, this can be challenging where space is limited and existing infrastructure is already tightly packed. Nevertheless, the potential benefits are significant, as SuDS can be incorporated into green spaces, parks, and even roadsides to capture and slow water runoff.

A successful example of retrofitting can be seen in Cardiff, the wettest city in the UK. The council transformed a central area into a focal square, with cycle lanes and 200m^2 of green areas.

Wavin's 'See Water Differently' event at London's Sky Garden

"There is huge potential to make our urban environments more resilient"

To tackle significant road runoff, SuDS were implemented in the form of rain gardens and tree pits, customised to support and work around the depth of existing utility pipework and cabling.

To realise the benefit of SuDS, the white paper calls for stronger regulation and policy. In England, the upcoming Schedule 3 of the Flood and Water Management Act 2010 and new Biodiversity Net Gain (BNG) legislation will direct the creation of SuDS. SuDS approval bodies and biodiversity experts will support developers.

However, the report warns that the BNG legislation is not as robust as it could be, as it allows offsite delivery of biodiversity gains, creating the risk that the urban areas most in need of biodiversity improvements may not benefit from SuDS initiatives.

Finding the space in urban areas for new SuDS programmes is challenging, and identifying suitable settings demands lateral thinking and innovative planning. The white paper includes a call to action to engineers across the industry. There's huge potential to make our urban environments more resilient but, as a society, we need to take action now. ●

Read the full white paper at bit.ly/SuDSwhitepaper

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Insulate pipework to unlock net zero

Commercial and industrial retrofits should upgrade poorly insulated pipework, say BESA and TICA

Insulating hundreds of miles of pipework in industrial and commercial buildings could significantly accelerate the UK's progress towards net zero goals while cutting operational costs, according to leading engineering bodies.

The Building Engineering Services Association (BESA) and the Thermal Insulation Contractors Association (TICA) identified uninsulated or poorly insulated pipework as the 'lowest of low-hanging fruit' among the potential building retrofit solutions.

BESA chief executive officer David Frise said that 'a concerted effort to address some of the most basic retrofit actions would deliver a massive and rapid return on investment'.

Research from the European Industrial Insulation Foundation (EiiF) revealed that insulating existing industrial pipework could cut carbon emissions by nearly 3.5 million tonnes annually.

TICA technical director Chris Ridge said: 'Trying to get either government or industry to recognise the gaping hole that exists in our national net zero strategy deployment, because of uninsulated or badly insulated pipework, is a major challenge.'

The recent launch of *BS EN 17956:2024 Energy efficiency classes for technical insulation systems. Calculation method and applications* could also make a huge difference, said TICA.

The standard, which was introduced in June, is based on the A–G energy rating model and provides a uniform basis for insulating pipework systems with a focus on efficient use of resources.

The EiiF has aligned its Tipcheck (technical insulation performance check) system with the new standard to help clients reduce their carbon and energy costs.

The standard specifies methods for the energy classification of insulation systems for components such as pipes, ducts, and equipment with an operational temperature range of –30°C up to 650°C.

'Anything that makes the specification of energy-saving thermal insulation easier to understand is most welcome,' said Ridge.

TICA has begun training apprentices on the fundamentals of thermal imaging and pipe insulation. ●

Best practice guide addresses pipe thickness levels

The Thermal Insulation Contractors Association (TICA) launched its first best practice document – *Thermal Insulation for Heat Network Retrofit Projects* – earlier this year.

The document was developed in collaboration with Fresh Heat Networks, a heat network client-side adviser.

Based on its experience in the sector, Fresh Heat Network found that a high standard of thermal insulation workmanship is key to ensuring the future efficiency and viability of heat network retrofit projects. It also concluded that the minimum thicknesses specified in CP1 (a 50mm-thick pipe insulation) are not always compatible with retrofit schemes because of restricted space.

The best practice guide includes insulation thicknesses in line with the 'enhanced levels' employed in the recent update to BS 5422. TICA said thickness levels are becoming the preferred standard for minimum performance when CP1 is neither applicable nor possible.

TICA's technical director, Chris Ridge, emphasised the significance of this document for improving heat network efficiency.

● **Thermal Insulation for Heat Network Retrofit Projects can be accessed at https://bit.ly/CJTIpip**

Grundfos pumps cool data centre

Water drawn from the nearby dock is used to efficiently regulate temperature of the server banks

Grundfos pumps have been used for a large cooling system at the Digital Realty Cloud House data centre in London Docklands.

The system draws water from the neighbouring Millwall inner dock to regulate the temperature of its server banks. The cool water passes through a primary set of pipe and a plate heat exchanger. This provides a cooling medium for the building's chilled-water loop, generating cooled air that passes via the air flow system through floor vents in the cold-aisle containment system, cooling racks.

The Grundfos pumping solution, chosen by design consultancy Deerns, provided the suction lift needed to raise the water from the dock, while maintaining a sufficient flowrate to ensure the return water temperature was no higher than 27°C, satisfying environmental health requirements.

To meet the needs of the client, Deerns specified a pumping system that would minimise water waste while carefully managing the volume and speed of water through the system, responding to changes in demand and meeting necessary conditions for the IT loa air conditioning system; Grundfos said any fluctuations in temperature could damage computer systems.

The solution given was the Grundfos NGB 150-124-315/336, an end-suction, close-coupled, single-stage submersible pump with high-efficiency IE3 motor and variable speed drive.

Grundfos says the system is 20 times more efficient that traditional cooling systems.

Rehau launches Ravipex pipe for heat networks

Rehau has launched the Ravipex pre-insulated pipe for heat networks.

It consists of Rehau's PE-Xa carrier pipes and a newly developed fine-pored polyurethane foam, which the company says creates the optimum combination of insulation performance and improved bending elasticity.

Rehaus says the flexibility reduces the bending forces required to install the pipework resulting in faster construction times.

The pipe features a longitudinal water barrier to ensure maximum protection if the outer jacket is damaged.

Call for gas valve checks every three years

Gas valves on distribution networks should be checked every three years, according to recommendations in Phase 2 of the Grenfell Tower Inquiry report.

The report also said the inspection results should be reported to the HSE as part of the gas safety case review.

Pipeline isolation valves are intended to enable the gas supply to be shut off in an emergency, but at Grenfell Tower they had been covered by hard landscaping.

The report found it was a common problem in the industry. It concluded: 'In our view that poses an unacceptable risk to health and safety and could have significant consequences.'

Expert witness Rodney Hancox also told the inquiry that gas pipework in old buildings was not sleeved as it passed between walls and floors, as required in the Gas Safety Regulations 1972. The inquiry said the HSE should consider Hancox's view that a 'more active approach to replacement be taken'.


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Managing risk of legionella

Understanding and managing legionella in water systems is a legal requirement. The Water Hygiene Centre's **Charlie Brain** warns of the dangers of not completing a risk assessment

In environments where there is a duty of care, such as healthcare facilities, residential homes and commercial buildings, it is a legal requirement to conduct a legionella risk assessment for water systems.

The Health and Safety Executive's (HSE's) Approved Code of Practice L8 (2013) stipulates that legionella risk assessments should be reviewed 'regularly' to ensure any changes in the water system or its use are identified, and that the risk assessment remains valid. Previously, the HSE recommended a two-year frequency for these assessments. In 2013, however, this was revised to align with other legislative documents, promoting assessments that are current, relevant, and proportionate to the identified risks. BS 8580-1:2019 outlines that a legionella risk assessment should be a continuous process rather than a one-off task, supporting the notion of a 'live document' that anticipates changes rather than merely reacting to them.

The Health and Social Care Act 2008: Code of Practice on the prevention and control of infections and related guidance requires the duty holder of a building to set up a water safety group (WSG) to manage and monitor the prevention and control of infection. According to the Department of Health's document HTM 04-01, the WSG should be consulted at the earliest opportunity when planning new healthcare premises or refurbishing existing ones, to ensure risk assessments are integral to all projects.

Commercial offices are at particular risk after the Covid-19 pandemic altered usage patterns (see panel, 'Legionella in commercial offices').

Using a review tool can highlight changes that might invalidate your current risk assessment. While some changes, such as a case of legionellosis, are obvious, others – such as modifications to the water system – require careful consideration. Significant changes, such as ward refurbishments or removing a cold-water tank, clearly necessitate a reassessment, while minor changes might warrant a reassessment if they alter the overall risk profile.

Review criteria are designed to predict changes in risk assessment findings impacting the written scheme of control, monitoring and maintenance tasks. Best practice suggests timely completion of risk assessments, especially after system installations or refurbishments. Identifying risks early allows for necessary adjustments, minimising users' exposure and avoiding costly fixes after the building is operational. During commissioning, well-documented risks often emerge that could have been addressed beforehand. Examples include:

- Flexible hose connections fitted to clinical wash basins behind integrated panel systems (IPS)
- Hot water tertiary loops not circulating
- Insufficient pipework insulation
- Over-storage of cold water
- Inadequate disinfection and water sampling records
- Inaccessible assets behind IPSs.

Addressing these can prevent unnecessary risks and interruptions once the building is in use, with contractors typically bearing the cost of rectifications before handover.

Failing to update a risk assessment can lead to several problems. New or altered risk systems may necessitate updates to the water safety plan or written scheme, requiring revised regimes of checks and inspections. Missed checks can cause irreparable damage or require costly remediation.

Changes in water storage requirements or usage can impact turnover times and increase biofilm growth risks, and different users with different susceptibilities, such as in healthcare, may require more frequent checks than public buildings.

Outdated risk assessments can result in HSE improvement notices, so regular reviews are crucial for maintaining up-to-date compliance and ensuring the right control measures are in place. ●

● **Charlie Brain is a senior consultant at the Water Hygiene Centre**

Legionella in commercial offices

The COVID-19 pandemic has affected water usage in buildings, leading to potential stagnation and increased legionella risk. It is crucial, therefore, to review risk assessments and adjust control measures accordingly.

In the UK, commercial building operators must adhere to the Health and Safety at Work etc Act 1974 to mitigate legionella risks. Each water system requires a legionella risk assessment and a control scheme that includes monitoring, inspection, cleaning, and disinfection.

Other considerations include scalding risks, the impact of hot-water boilers and drinking-water dispensers on water usage, and ensuring regular use and maintenance of all water outlets.

Safety at every turn

Care homes and hospitals require specialist plumbing installations to ensure safety and reliability. **Richard Bateman** of Reliance Valves looks at the key steps to consider in the design

Ensuring plumbing systems are safe for vulnerable users in care homes and hospitals is crucial.

In healthcare settings this importance is magnified due to the number of patients, staff and visitors who rely on the water supply. A well-designed plumbing system protects health by preventing incidents like scalding and bacterial contamination, which poses a significant risk in healthcare environments.

Key to safe plumbing systems are water control valves that manage functions such as flow through and temperature regulation.

These solutions ensure the demands are met across the entire building, creating a safe and robust water system, which is one of the most critical foundations for hospitals and care homes. Every system must be designed to suit the complexities of everyday demands.

Understand the environment

While there are similarities in the plumbing installations of every care home and hospital, each one is unique – particularly when looking at the large-scale commercial systems. These systems are not only substantial in their scale, but also have the potential to serve hundreds – if not thousands – of people each day.

These characteristics shape the safety considerations for system specifiers and installers. Larger buildings will typically have higher water pressures for which plumbing systems will need to be equipped, while user demand will fluctuate considerably throughout the course of a day. That's why it's important to gain a comprehensive understanding of the environment from the start when designing safe plumbing systems.

For the best results, it is good practice to consider plumbing systems as a whole, despite the size of the hospital or care home. This ensures the correct water control valves are selected to achieve optimum results, with each performing their individual roles to cumulatively deliver safe and reliable performance.

Optimise plumbing systems for health and safety

Health and safety are priorities in healthcare facilities, with the risks of scalding and legionella contamination two of the most pressing concerns.

Thermostatic mixing valves (TMVs) are essential components in these environments, as they blend hot and cold water to create a stable outlet temperature.

Valves like the Heatguard TMV3-8 TMV are specifically approved for healthcare applications, delivering water at safe temperatures and shutting off if the cold-water supply fails to prevent unregulated temperatures being available to the user.

It is essential that TMVs that are used in healthcare environments meet the TMV3 Scheme criteria, which sees them tested against a range of pressures to ensure they meet the necessary safety standards. TMV3-approved valves also meet the strict criteria set out by the NHS D08 specification, requiring TMVs to maintain a constant outlet pressure despite any fluctuations in the temperature or pressure of the water supply.

Ensure the supply remains safe

When considering safe water temperatures for healthcare environments, scalding is just one part of the puzzle. At the other end of the scale, where cold water supplies can rise to ambient temperature levels, Legionnaires' disease becomes a concern. Therefore, using solutions that can enable the delicate balance of water temperature is important in maintaining system safety.

The risks of scalding and legionella contamination are two of the most pressing concerns

Legionella bacteria thrive in moderate temperatures and stagnant water. If the bacteria grows and patients, staff or visitors contract Legionnaires' disease, the consequences can be dangerous, particularly in hospitals and care homes where many people are already vulnerable and susceptible to infection.

Anti-legionella valves need to be fitted to expansion or cold-water storage tanks to prevent bacteria from contaminating a water supply. The valves continuously renew the water content to maintain circulation and prevent stagnation – removing one of the fundamental environmental characteristics that support the bacteria's growth.

These valves will work alongside solutions such as thermal balancing valves and thermostatic mixing valves to make sure the circulating hot water temperature remains high and consistent across a building, ensuring

efficiency, while safeguarding against scalding at the point of use.

Prevent backflow

The scale of care home and hospital facilities means that not only does the safety of people on site need to be considered, but in the event of contamination, even other properties using the common water supply network can be put at risk.

Backflow occurs when sudden drops in pressure force water to move in the opposite direction and ultimately contaminate the water supply. It poses a particular threat to larger care home and hospital plumbing installations.

Some occurrences of backflow are more severe than others. This is outlined through five fluid categories, with category 1 being the lowest risk and categories 4 and 5 presenting significant risk. Buildings that fall into these high-risk categories – including hospitals – must take additional

precautions to minimise the potential for backflow.

To prevent it, reduced pressure zone (RPZ) valves must be installed in healthcare settings. This is achieved by ensuring that water in the system remains at a lower pressure than the incoming supply. These valves, like the commercial type BA RPZ valve, provide the highest level of mechanical protection against backflow, ensuring compliance and maintaining the required levels of safety across fluid category 4 environments.

Maintain systems regularly

Installing the appropriate valves in plumbing systems is just part of the solution. Regular maintenance performed by qualified installers is critical to ensure continued performance and to safeguard the water supply.

Given the complexity of plumbing systems in healthcare buildings, maintenance should be as straightforward as possible.

Valves should be easily accessible to minimise disruption for staff and patients. Just as incorrect installation may result in an increased risk of contamination, so too could inconsistent maintenance, making it an essential consideration for plumbing professionals supporting healthcare facilities. ●

● **Richard Bateman is product marketing manager, plumbing and heating, at Reliance Valves**

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CPD programme
Indoor air quality

Measuring and controlling IAQ in indoor environments

This module considers the main contaminants impacting on indoor air quality (IAQ), their measurement in building systems and methods for enhancing it

This CPD article explores some of the principal contaminants that negatively affect indoor air quality (IAQ), how they might be measured in building systems, and considers demand control ventilation as a means of enhancing IAQ.

As discussed in a UK Parliament briefing paper,[1] air pollution is causally linked to an increased risk of several serious health conditions, including heart disease, stroke, certain cancers, dementia, cognitive decline, impaired lung growth, and various respiratory illnesses. The impact of typical ambient (external) pollutants are represented in Figure 1, as summarised by the European Environment Agency (EEA).[2] Additionally, volatile organic compounds (VOCs) – such as formaldehyde – can have a range of health effects, depending on the specific VOC concentration and duration of exposure. These include eye, nose, and throat irritation, headaches, dizziness, and fatigue. Prolonged exposure to VOCs can damage the liver, kidneys and central nervous system, and certain VOCs are known – or suspected – carcinogens. This covers exposure to the headline VOC groups phthalates[3] (commonly used to add flexibility and durability to plastics, such as flooring), and per/poly-fluorinated substances (PFAS)[4] that are widely used in various building materials, flooring and fabrics owing to their desirable properties like water-, stain- and heat-resistance.

There have been many attempts to quantify the influence of the various sources of pollutants into the internal space; however, individuals are exposed to a wide range of pollutants as they move through different indoor environments, each with its unique set of pollutant sources. Climate change is likely to adversely impact IAQ by increasing the infiltration of outdoor pollutants including ozone and particulate matter. Higher temperatures and humidity levels promote the growth of mould, dust mites and allergens indoors, contributing to respiratory issues. Inappropriately filtered or controlled HVAC systems can inadvertently circulate these pollutants, further deteriorating air quality.

The recent study[5] by Saraga et al. examined 127 international peer-reviewed studies, revealing a significant variation in contaminants affecting IAQ in occupied environments, with no clear or consistent pattern emerging. However, the review identified that off-gassing from building materials, surface coatings and wood-based products dominated as sources of VOCs. There is no practical method of continuously sensing viruses and bacteria in buildings and HVAC systems so the level of risk will typically need to be assessed and proactive control mechanisms employed as deemed necessary, such as high-efficiency filters and ultraviolet germicidal irradiation (UVGI), and by controlling the volumes of ventilation air.

A 2022 report by the UK Department for Environment Food and Rural Affairs (Defra) Air Quality Expert Group[6] highlighted specific IAQ concerns across different environments. In care homes, limited ventilation resulting from restricted window openings can lead to the accumulation of pollutants. Several research projects have identified inadequate – or improperly controlled – ventilation as a cause of poor IAQ in social housing. As shown by McGill et al.,[7] this is not confined to 'legacy' homes. They investigated homes built to high sustainable standards, and their findings suggest inadequate IAQ and thermal comfort in the dwellings.

Nurseries and schools, where children spend significant time, often have limited ventilation to reduce heating costs, resulting in high levels of pollutants including carbon monoxide (CO), carbon dioxide (CO_2), particulate matter (PM), and VOCs, especially in urban or high-traffic areas.[6] Hospitals typically demand specialised consideration of ventilation.[8]

Some workplaces can present specific air quality risks, particularly in sectors like manufacturing and construction, where exposure to substances such as asbestos, particulates and VOCs is common. As noted by the US Environmental Protection Agency (EPA),[9] office occupants may be exposed to a mix of

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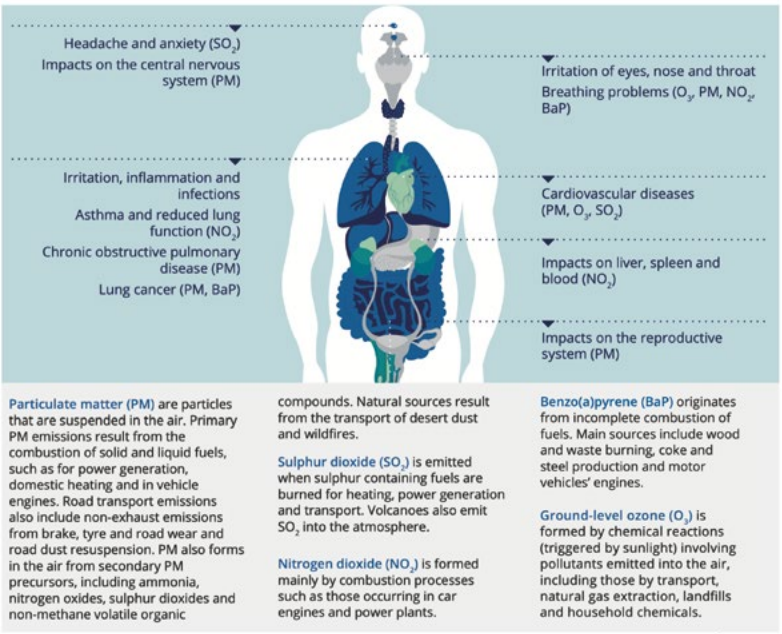

Figure 1: Major sources of ambient air pollution and potential human health impacts[2]

contaminants from indoor pollution sources that are potentially exacerbated as a result of poorly designed, maintained or operated ventilation systems, and unanticipated or inadequately planned building use. Office surveys undertaken by the EPA identified asbestos and organics from building materials; formaldehyde from pressed wood products; off-gassing from carpets and other office furnishings; chemicals released from cleaning materials, air fresheners, paints and adhesives; ozone from copying machines; biological contaminants from dirty ventilation systems and water-damaged walls, ceilings and carpets; and pesticides from pest management practices. Laurent et al considered[10] both the impact of CO_2 and $PM_{2.5}$ (particles with a diameter of 2.5µm or less) on the performance of office workers and identified the acute impacts on cognitive function associated with poor IAQ, concluding that benefits from reducing exposures to $PM_{2.5}$ and CO_2 indoors may positively impact productivity, educational attainment, safety and activities where cognitive performance is important.

Chemical reactions, such as those involving nitrogen oxides (NOx) and VOCs in the presence of sunlight and other atmospheric conditions, can form fine particulate matter, known as secondary PM that can contribute significantly to the total $PM_{2.5}$ and PM_{10} levels. The UK Health and Safety Executive (HSE) guideline suggests that total VOC levels should not exceed 300µg·m^{-3} averaged over eight hours, and the formaldehyde recommended limit is 100µg·m^{-3} over 30 minutes.

The recently published review[11] of air-pollution sensors refers to the growing trend of low-cost sensors (LCS) that, as technology develops, allows the wider deployment of sensing devices, which are sufficiently reliable and robust while also being less costly than research- or reference-grade sensors.

The most prevalent PM sensor is optical, which employs LED light scattering to detect particles and is considered as being reasonably accurate for indoor use, but can be affected by humidity and temperature changes. They are likely sufficient for most consumer (and general HVAC) applications and have an accuracy range of ±10–20% compared with reference-grade instruments. More expensive, laser-scattering sensors provide better accuracy, especially in controlled environments, and are likely to be accurate to within ±5–10% compared with the reference. Regular maintenance, including cleaning and replacing filters, and regular calibration help ensure sensors remain accurate over time.[12]

Non-dispersive infrared (NDIR) is the most common type of CO_2 sensor used in HVAC systems[13] (and is the technology specified in the England Building Regulation AD Part F1 for typical commercial spaces). They are favoured for their high accuracy, reliability and long-term stability. NDIR technology relies on the principle of infrared absorption by CO_2. Infrared light is passed through the sensor's gas chamber and through a CO_2 selective optical filter before reaching the detector. The detector measures the intensity of infrared light and converts it into a calibrated electrical signal – higher concentrations of CO_2 result in a weaker electrical signal. In ideal conditions, a well-calibrated NDIR sensor can provide readings within ±1–5% of the reference value. CO_2 sensors will tend to drift over time, leading to a gradual decrease in the sensor's ability to accurately measure CO_2 levels.

The choice of VOC sensors for HVAC systems often depends on the specific requirements for sensitivity, response time and budget. Metal-oxide semiconductor (MOS) sensors that measure changes in the resistance of a metal-oxide layer when exposed to gases are relatively low cost but are very susceptible to humidity and temperature variations. The more expensive NDIR sensors can be employed to provide selective measurements of specific VOCs. Similarly-priced electrochemical sensors measure VOCs through a chemical reaction that generates an electrical current, providing high accuracy for a limited range of VOCs over a relatively short lifespan (said to be in the order of three years). Photoionisation detectors (PID) – at about 10 times the cost of MOS sensors – use ultraviolet light to ionise VOCs, and can detect low levels of a wide range of VOCs (in the ppb range). However, in common with most high-end sensors, these require regular and relatively frequent calibration and maintenance.

Commercial buildings are normally ventilated with outdoor air to replace the vitiated air and to dilute air contaminants created by occupants and their activities ('anthropogenic' activity). Standards and guidelines (such as CIBSE Guide A) specify the minimum amount of outdoor air that is to be supplied by ventilation systems based on occupancy conditions (or area-based values for sparsely occupied spaces). This assumes that the quality of outdoor air is good. If outdoor concentrations of contaminants are continuously or intermittently high, then it is critical to devise control measures to not inadvertently worsen IAQ through ventilation. Office buildings often have transient occupancy, and conditions that are generally below the maximum capacity and, hence, energy may be wasted through over-ventilation.

An approach to solving this problem is demand control ventilation (DCV), which could be provided by the system in Figure 2.

DCV is a building ventilation strategy that adjusts the amount of outdoor air provided to a space based on the occupancy and activity level and, potentially, in response to the levels of specific pollutants in the indoor (and outdoor) air. In a recirculation air system, this could be by modulating the mixing dampers to vary the proportion of outdoor air, or perhaps by simply using variable speed fans and possibly employing volume control dampers to alter the supply of ventilation air to all – or specific areas of – the building. Since human respiration produces CO_2, it has often provided a useful proxy to indicate occupancy levels and, where IAQ is dominated by occupancy-related emissions, CO_2-sensing is well established as a means of controlling effective DCV. Sensors, typically placed in the return air ducts or within the occupied spaces, continuously feedback the concentration of CO_2 in the air. As CO_2 levels rise above a pre-determined threshold (indicating increased occupancy), the DCV system responds by supplying more outdoor air to dilute the contaminants in the indoor air. Conversely, when CO_2 levels are low (indicating reduced occupancy), the system reduces the ventilation rate. Such systems can also provide reduced, or no, airflow during unoccupied periods – this can be controlled by a combination of sensors and timed switching. Developments of LCS has opened opportunities for more applications of particulate and specific gas sensors that, working alongside CO_2 sensing, can offer a more detailed interpretation of the IAQ in situations that may not be dominated by occupant activity. The DCV control systems use this data to adjust the ventilation rates. DCV systems can significantly reduce energy consumption for heating, cooling and ventilating a building by providing ventilation based on real-time needs. This is particularly important in large buildings or spaces with variable use, such as offices, schools and auditoriums.

As noted in CIBSE Commissioning Code A,[14] the system designer has a prime responsibility for the provision of sufficient outside air. The systems should include a suitable degree of filtration not only to make incoming outside air as 'clean' as possible, but also to remove detritus from the return air from the building prior to its travel through an air handling unit (AHU). There may also be a need to employ more extensive methods of air cleaning to allow the recirculation of otherwise contaminated air.

Understanding the diverse range of contaminants – including particulate matter, VOCs and biological aerosols – is crucial for developing effective strategies to mitigate their impact on health and wellbeing. DCV can provide a useful approach to managing IAQ by adjusting ventilation rates based on real-time data, thereby enhancing air quality while optimising energy efficiency. However, as the understanding of indoor pollutants and their effects continues to advance, ventilation systems and their sensing and control mechanisms will need to evolve to ensure the wellbeing of occupants while meeting standards of environmental sustainability. ●

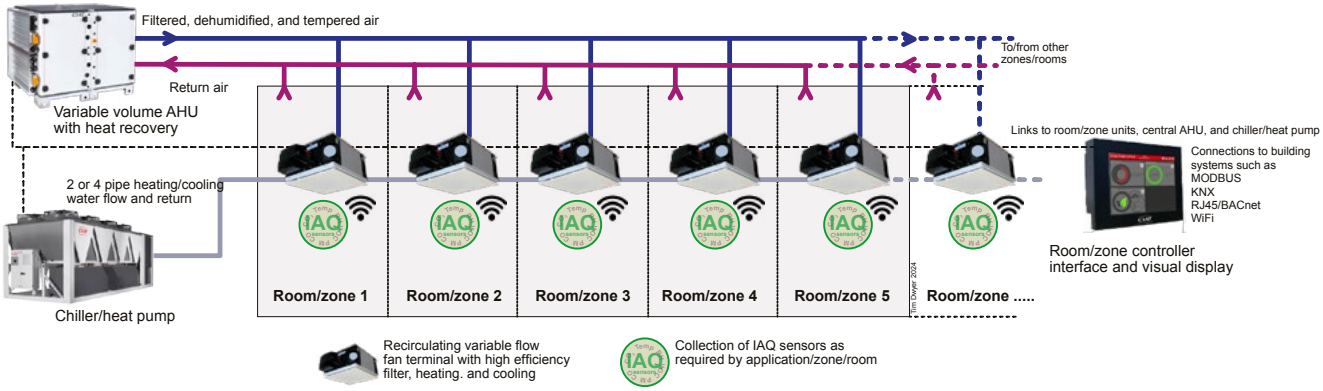

Figure 2: An example of a DCV system employing variable speed main AHU to deliver partially conditioned outdoor air-to-fan assisted recirculating terminal units. The balance of outdoor air to recirculated room air being supplied from the terminal is maintained based on information provided by the IAQ sensors (used as required)

Module 238

October 2024

1. Which of these was not noted in the article as being identified in the EPA office surveys?

- ☐ A Asbestos
- ☐ B Biological contaminants
- ☐ C Formaldehyde
- ☐ D Ozone
- ☐ E PFAS

2. What is the primary mechanism behind NDIR sensors used for measuring CO_2 levels?

- ☐ A Changes in electrical resistance due to gas exposure
- ☐ B The ionisation of gas molecules using ultraviolet light
- ☐ C Infrared absorption by CO_2 molecules in the air
- ☐ D Light scattering by particles in the air
- ☐ E Variations in capacitance of sensor

3. What health issue is considered to be caused by prolonged exposure to VOCs?

- ☐ A Bacterial infections
- ☐ B Chickenpox
- ☐ C Damage to the liver
- ☐ D Legionnaires' disease
- ☐ E Skin infections

4. Why are phthalates considered a concern for indoor air quality?

- ☐ A They are a byproduct of HVAC system operation
- ☐ B They are commonly used in cleaning products
- ☐ C They are found in plastics used in flooring and can off-gas into the air
- ☐ D They are released from building materials exposed to high humidity
- ☐ E They are significant components of polluted outdoor air

5. What is the normal main function of demand control ventilation (DCV)?

- ☐ A To adjust ventilation rates based on factors like occupancy and pollutant levels
- ☐ B To allow improved humidity control by limiting outdoor air
- ☐ C To completely eliminate the need for air filtration
- ☐ D To maintain a constant temperature throughout a building
- ☐ E To remove all biological contaminants from the air supply

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Products of the month

Ideal Heating expands Evojet boiler range

New models offer up to 3,000kW output

Ideal Heating – Commercial Products has expanded its Evojet pressure jet boiler range with the introduction of four new models, extending the series' output capabilities to 3,000kW. The existing range begins at 150kW, and the new additions bring the total number of models in the line to 14.

Known for their high efficiency and advanced condensing operation, Evojet boilers feature burner modulation capabilities, enhancing their performance across various applications.

The new models come with outputs of 1,750kW, 2,100kW, 2,600kW and 3,000kW, making them ideal for large-scale installations such as hospitals, leisure facilities, heat networks, and commercial buildings. These powerful, floor-standing condensing boilers offer a space-saving alternative to larger cascades made up of smaller-capacity units.

One of the key features of the new boilers is their double-return condensing system, which allows high- or low-temperature return water connections. This technology maximises the temperature difference between the heat exchanger wall and return water, optimising condensation and increasing overall efficiency. The boilers also boast a 3-pass layout, titanium-stabilised stainless steel components, and extensive insulation, ensuring long-term reliability and performance.

Evojet boilers are compatible with various burner types, providing flexibility in installation. The burner modulation, which can be managed through a 0–10 volt building management system or RWF controller, helps the boilers meet the seasonal efficiency requirements of Building Regulations Part L Vol.2 2022. They are also compliant with the Medium Combustion Plant Directive for NOx emissions. All models come with a two-year warranty.

Ideal Heating, part of Groupe Atlantic, has been a leading UK manufacturer of high-efficiency commercial heating solutions since 1906, operating from its Hull-based manufacturing plant.

● **Visit idealcommercialboilers.com/products/evojet**

Johnson Controls-Hitachi launches award-winning VRF system

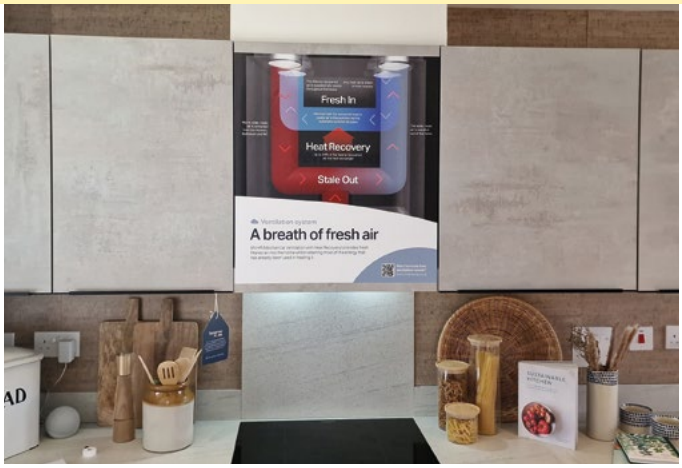
Johnson Controls-Hitachi Air Conditioning Europe has launched the air365 Max, a top-flow variable refrigerant flow (VRF) air conditioning system for HVAC professionals, architects, and building owners.

Available in two models – air365 Max and the high-efficiency air365 Max Pro – the system offers energy-efficient heating and cooling, with heat pump and heat recovery features as standard. Both models support more than 64 Set Free indoor units, enhancing installation flexibility.

The air365 Max series uses Hitachi's SmoothDrive 2.0 technology, achieving seasonal energy efficiency ratio ratings of up to 8.38 and seasonal coefficient of performance ratings of up to 5.19. This ensures optimal comfort and energy efficiency. Additionally, the airCloud Tap app enables faster installation via NFC technology, reducing setup time by up to 50%.

The air365 Max was awarded Air Conditioning Product of the Year at the ACR & Heat Pump Awards 2024, and offers remote monitoring and control for increased operational efficiency.

● **For more information visit www.hitachi-hvac.co.uk**



Vent-Axia powers sustainable ventilation for Tomorrow Home project

Vent-Axia has been selected to provide ventilation solutions for Lovell Homes' Tomorrow Home project in Spennymoor, County Durham. The project features two semi-detached homes designed to test sustainable technologies.

Vent-Axia's Lo-Carbon Sentinel Kinetic Cooker Hood MVHR and Lo-Carbon NBR dMEV C systems have been installed to evaluate their effectiveness in improving indoor air quality and energy efficiency.

Data collected will help assess their performance against anticipated Future Homes Standards. The project aims to provide insights into sustainable heating and ventilation solutions for net zero homes.

● **Call +44 (0)344 856 0590 or visit corporate.lovell.co.uk/tomorrow-home**

Directory

Your guide to building services suppliers

Pump Technology develops eco-friendly wastewater systems

Pump Technology is now offering a more environmentally friendly option for wastewater pumping systems. The Jung Pumpen DrainMinor and DrainMajor ranges feature tanks made from polyethylene, a material that is easily recyclable, making them an eco-conscious alternative to traditional glass reinforced plastic (GRP) tanks.

For advice on wastewater and sewage pump specifications, contact the Pump Technology team, based in Berkshire

● **Call 0118 9821 555 or visit www.jung-pumps.co.uk**

GF Building Flow Solutions launches CPD on optimising heat networks

GF Building Flow Solutions (formerly Uponor) has introduced a new CIBSE-accredited CPD, 'Minimise the heat and energy losses of heat networks'.

The session is designed for building services engineers, and covers the importance of community and district heating networks, relevant legislation, and how to optimise system performance with pre-insulated pipe systems. Attendees will gain an insight into heat network design, sustainable heating, and funding opportunities.

● **Call 01923 381212 or visit www.uponorgroup.com/en-en**

New fellows, members and associates

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Croly, Christopher
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Warwick, United Kingdom

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Tai Po, Hong Kong

Tang, Sher Kin Kelvin
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Tonbridge, United Kingdom

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Biler, Ahmet
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Singapore, Republic of Singapore

Bousquet, Sarah Raphaelle Marie
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London, United Kingdom

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Sai Wan Ho, Hong Kong

Chiu, Pit Fai
Sha Tin, Hong Kong

Conhyea, Oomesh
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Plymouth, United Kingdom

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Phoenixville, United States

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Q&A

Urban design is shifting towards creating liveable, walkable cities that prioritise health and sustainability. Buro Happold's **Kathryn Woolley** explains how biophilic design and active travel is creating healthier and more resilient urban spaces

The idea of designing healthier cities has gained momentum as urban areas strive to create environments that promote wellbeing and sustainability. CIBSE President Fiona Cousins is leading the way with her focus on 'Building Performance Reimagined', exploring the intersections of engineering, sustainability and design.

Kathryn Woolley, air quality lead at Buro Happold, shares the approaches that are being employed to transform cities, such as biophilic design and projects that encourage more people to walk.

Q How does enhancing walkability contribute to a healthier urban environment?

A A quarter of our everyday trips are less than one-mile long, and several studies have shown that walking can improve your physical and mental health; it is even being trialled as a social prescription in places such as Leeds and Bradford. Walking is one of the most accessible forms of transport and is an important part of making our environments happier, healthier, and more inclusive.

What is the Great British Engineering Adventure?

In collaboration with social enterprise Footways, Buro Happold has created a series of mapped walking routes that showcase cities' incredible feats of engineering on foot. The first – the Rail and Heritage Loop – is a circular route that links 10 of London's rail stations, all wonders of engineering. It follows quiet, feature-filled streets; seeks out the city's engineering heritage; follows the Thames, Regent's Canal and London's hidden rivers, and crosses beautiful green spaces. The 18-mile loop is accessible by public transport, and can be walked in sections – or in one go if you're feeling ambitious.

How does the project align with Buro Happold's vision?

We want to move away from 'predict and provide' planning, where decisions are based on past trends, and move towards 'vision-based' planning, which is grounded in creating spaces that align with local decarbonisation objectives. This means managing land use and creating opportunities for people to walk, wheel or cycle to multiple everyday amenities.

We're excited that the proposed changes to the National Planning Policy Framework appear to embrace this approach, prioritising creating healthier, sustainable cities.

How do projects such as this minimise pollution and improve air quality?

Transport is one of the largest sources of air pollution in the UK. While the transition to electric vehicles reduces tailpipe emissions, it doesn't fully address pollution caused by tyre wear and braking. Improving public transport and shifting to active travel are key ways to reduce air pollution.

"Transport is one of the largest sources of air pollution"

How can we incorporate biophilic design principles into urban projects?

Biophilic design integrates environmental features within the overall design. This is important in an urban setting, where there can be limited access to green space. It can include tree planting, rain gardens and biodiverse roofs, providing habitat for wildlife and other benefits, such as improved air quality, a reduced heat island effect, and improved wellbeing.

How can we create urban projects that are resilient and adaptable?

Urban planning must go beyond physical mobility, to consider how people interact with their environment and the services available to them. We can test the resilience of different strategies to climate change and population growth to make informed decisions about the future.

Nature-based solutions are a key part of the long-term solution for climate resilience. There are multiple drivers for this approach: reduced grey infrastructure; less embodied carbon; sustainable solutions to engineering challenges; and the reduction of the urban heat island effect. Vegetation lowers surface and air temperatures by providing shade and cooling through evapotranspiration.

Our nature and biodiversity team works with clients and stakeholders to review opportunities for addressing the urban heat island effect at an early stage. Trees can significantly lower surrounding temperatures, which improves thermal comfort and can reduce the need for air conditioning . We recommend retaining existing trees and planting new ones, which improves the biodiversity net gain score. ●

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CMR FLOWGRID

The FGG Flowgrid has been designed to measure air volume in ventilation ducts. The Flowgrid consists of a standard duct section with a length of 200 and 300 mm and is available with a 20-30 or 40mm duct connection flange to suit standard duct work

The CMR sensing probes are fitted across the internal duct frame area in predefined spacing. Each probe has a number of pressure inlet points to measure the impact and static pressure at the same time and provide an average velocity measurement.

The result is a velocity pressure which ultimately provides a total air volume measurement. Both static and impact pressure have an independent pressure averaging tank which provides a smooth pressure signal of the whole measured area.

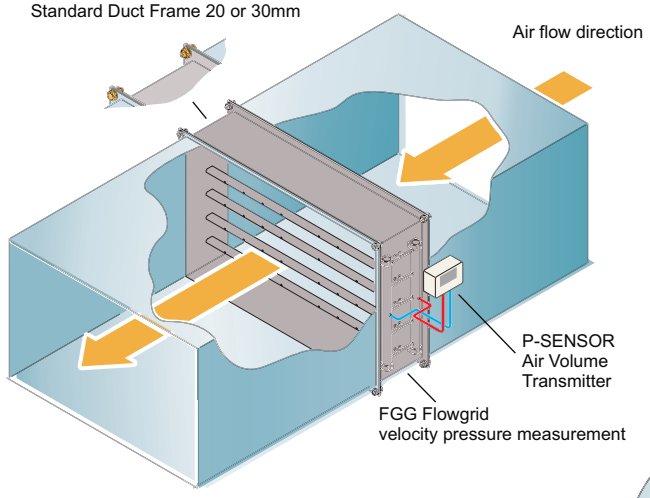
Another great advantage of the FGG Flowgrid is, that it can measure bi-directional as it is manufactured equally on both sides. This means, the air flow is measured in one direction and should there be a reverse flow, this can be detected and measured when using the CMR P-SENSOR.

The Flowgrids are manufactured in standard height increments of 100mm going up to a maximum height of 1200mm. Custom sizes can be made 3000 x 3000mm

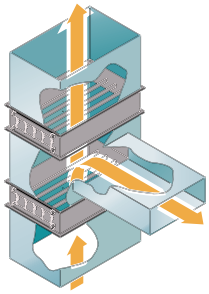
The Flowgrids are installed in many projects such as

Commercial Buildings - Industrial Production Plants - Pharmaceutical Production - Validated Monitoring Systems Hospital Isolation Rooms - Operating Theatres - Data Centres

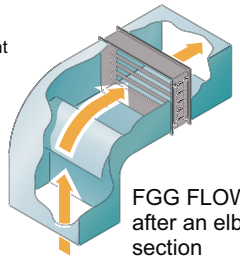
FGG FLOWGRID and P-SENSOR providing accurate average air volume measurement in ducts.



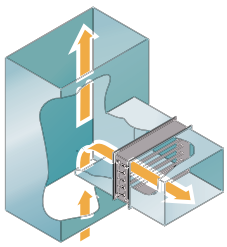
P-SENSOR
With LCD display
and keyboard



FGG FLOWGRID
before and after a
T- duct section



FGG FLOWGRID
after an elbow duct
section



FGG FLOWGRID
in a T- duct section

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