

CIBSE **JOURNAL**

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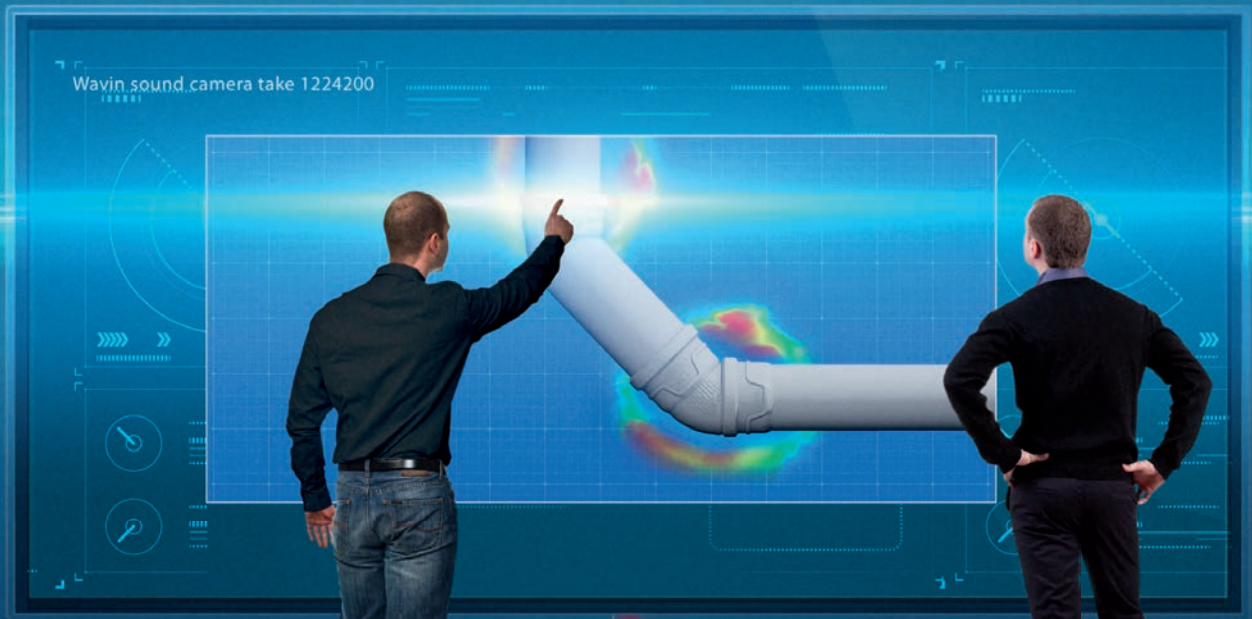
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Levelling up



One of the four main goals of UN Climate Change Conference COP26 is for countries to come forward with ambitious 2030 emissions-reduction targets, with the aim of achieving net zero by 2050. In rich developed nations, the goals should be achievable as long as politicians have the will and nerve to enact the necessary carbon-cutting measures.

For poor countries with high poverty levels and no means to switch from fossil fuels to renewables, it's a different matter, and the ability to cut building emissions will be extremely challenging without external help.

Our cover feature tells the story of one organisation that has come up with a way of improving the

energy performance of housing in areas with limited access to skills, finance and materials. In 2015, the founders of Doh Eain helped finance the retrofit of a family home in Yangon, Myanmar. In parallel, it encouraged the local community to turn neighbourhood 'trash alleys' into pleasant communal spaces.

Six years on, it has retrofitted numerous historic properties and proved that the simple measures of increased insulation and double glazing are leading to much lower energy use and costs than in neighbouring new-build homes.

Myanmar's February coup has curtailed work in the country, but Doh Eain is now looking to replicate its model in countries with similar challenges, such as the Philippines, Georgia, Indonesia, Thailand and India. Doh Eain says the project is particularly targeted at private homeowners who do not have the resources to improve their dwellings. Without a means of renovating millions of privately owned homes, poorer countries will have little chance of meeting the UN's ambitious climate goals (page 26).

The UK has the access to finance and skills, but buildings often fail because of the construction process, which does not require the operation of buildings to match the intended design. A new tool has been created to track changes in energy loads during the design phase, to help ensure that the consequences of changing a designer's specification – in terms of cost, energy use and carbon emissions – are plain for all to see. One advantage of the Operational Energy and Carbon tool is its simplicity. It is spreadsheet-based, so does not require a high degree of skill, and it won't take up much room on the server (page 34).

This month, the cream of our industry's young talent will once more be competing for the accolades of CIBSE ASHRAE Graduate and Apprentice of the Year. The event, on October 14, will be virtual again, giving the young engineers an opportunity to show off the online presentations skills honed during lockdown (page 22).

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CONTRIBUTORS



Hywel Davies
 New guidance explains why the HSE is expecting a building's safety to be addressed independently



Roderic Bunn
 A cultural reset in the construction industry is required if the goal of operational net zero is to be realised



Julie Godefroy
 Why members should have their say on what net zero carbon definition should be adopted by CIBSE



Tim Dwyer
 October's CPD explores the use of isolation valves in domestic and commercial HVAC applications

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MOSQUE IS STIRLING PRIZE FRONTRUNNER

A Cambridge mosque is favourite to win this year's RIBA Stirling Prize. The six shortlisted projects also include Amin Taha's 15 Clerkenwell Close, which had been threatened with demolition because of a long-running planning dispute that was finally resolved in 2019. Also shortlisted are a Cornwall bridge, a Kingston university building, and a Lake District museum. 'The shortlist demonstrates the innovation and ambition that lies at the heart of exceptional architecture,' said RIBA president Simon Alford. The winner will be announced on 14 October. For more on the mosque, see 'Cool to prayer', August 2019, *CIBSE Journal*.



WHO slashes air-quality limits to save lives

Pollution causes seven million premature deaths a year worldwide

The World Health Organization (WHO) has slashed maximum safe levels of several pollutants, warning that air pollution is even more dangerous than previously thought.

It has linked long-term exposure to even relatively low concentrations of ambient and household air pollution to lung cancer, heart disease and strokes, putting the health impact of pollution on a par with poor diet and smoking.

The WHO has reduced almost all of its previous maximum-target levels of pollutants. The recommended limit for average annual exposure to PM2.5 has been halved from 10 micrograms per cubic metre to five, and the recommended limit for PM10 has been lowered from 20 micrograms to 15.

'Almost 80% of deaths related to PM2.5 could be avoided if current air-pollution levels were reduced to those proposed in the updated guideline,' the WHO said, explaining that these are primarily generated by fuel combustion in transport, energy, households, industry and agriculture.

It added that exposure to air pollution is estimated to cause 7 million

premature deaths: 'Improving air quality can enhance climate change mitigation efforts, while reducing emissions will, in turn, improve air quality.'

Disparities in air pollution exposure are increasing worldwide, the WHO said, particularly as low- and middle-income countries are experiencing growing levels of air pollution because of large-scale urbanisation that has largely relied on burning fossil fuels.

'These targets reinforce the relevance of CIBSE guidance and underline the value of BS EN 16798-3 for the ventilation of non-domestic buildings, now being aligned with them', said CIBSE technical director Hywel Davies.

WHO has warned that air pollution is even more dangerous than previously thought



Construction code launched

The Construction Products Association (CPA) has launched its much-heralded Code for Construction Product Information (CCPI) in a bid to improve the way manufacturers present their product details to the market.

The 11-point Code has been built on the principle that product information must be 'clear, accurate, up to date, accessible and unambiguous', the association said. '[It also] promotes urgent positive culture and behaviour change in the approach and management of product information.'

The CPA added that the Code is designed to make 'disingenuous marketing practices and the provision of misleading product information... a thing of the past'.

Green grant scheme was 'rushed', says NAO

The Green Homes Grant Voucher Scheme was delivered to an over-ambitious timetable and not executed to an acceptable standard, according to a report from the National Audit Office (NAO).

The Department for Business, Energy & Industrial Strategy (BEIS) originally expected the scheme to support up to 82,500 jobs over six months and enable up to 600,000 households to save up to £600 on their energy bills. The scheme fell well short of those targets and is expected to have used just £314m of the £1.5bn funding available.

The NAO also said BEIS did not understand the challenges facing installers and 'failed to learn from its own previous energy schemes' by not consulting with the industry until after it had been launched.

Scottish hospital inquiry into ventilation and water safety

An independent inquiry into two hospitals beset by contaminated air and water supplies has started hearing evidence.

It was ordered after patients died at the Queen Elizabeth University Hospital Campus in Glasgow from infections linked to pigeon droppings in the water supply, and the opening of the Royal Hospital for Children and Young People and Department of Clinical Neurosciences in Edinburgh was delayed because of concerns over the ventilation system.

The inquiry will determine how the issues affected patient safety and care, and whether they could have been prevented. It will make recommendations to ensure any past mistakes are not repeated in future NHS infrastructure projects.

Inquiry chair Lord Brodie said: 'Our role is to understand what went wrong with the construction of these hospitals so lessons can be learned to prevent the recurrence of such issues in the future.'

Job vacancies hit all-time high

Job vacancies in construction have risen to their highest level since official records began 20 years ago.

Figures from the Office for National Statistics show that the reopening of the sector has created unprecedented competition for workers and put supply chains under intense delivery pressures.

From June to August, the number of vacancies rose to 37,000, more than 15% higher than March to May and more than double the same period a year ago. This equates to around 2.4 vacancies per 100 jobs.

Grenfell suppliers 'exploited' confusion around fire regs

Lead contractor Rydon accuses manufacturers at public inquiry

The lead contractor on the Grenfell Tower refurbishment has accused its suppliers of taking advantage of confusion about fire regulations to provide unsafe products and services during the project.

Rydon told the public inquiry that it had relied on cladding and insulation manufacturers to sell safe materials and the architect to better understand what was being specified.



The company's lawyer, Marcus Taverner QC, said the regulations were confusing and this left them open to 'deliberate exploitation by manufacturers such as [cladding manufacturer] Arconic, [insulation manufacturer] Celotex, [insulation manufacturer] Kingspan and [cavity barrier supplier] Siderise to sell dangerous products'.

He said Rydon had also trusted the architect, Studio E, and façade expert Harley to do a better job.

However, Kingspan said it had explained that its K15 insulation could only be used on projects such as Grenfell Tower if additional tests were carried out. It added that it was 'a matter for designers, cladding contractors and architects' to decide how it should be used.

Arconic claimed its products could be used in safe ways, but they had been combined with unsafe components at Grenfell. Celotex also said there was no evidence that it had misled the project team and the responsibility for the problems lay with the contractors.

Siderise added that it only had responsibility for one component, so was not responsible for carrying out safety tests on the whole installation.

However, a barrister representing the Grenfell families blamed all the parties involved and said there had been 'a total neglect of safety'. Stephanie Barwise QC described the design team as 'inept' and the consultants as 'hapless'. She added that some workers and contractors were 'reckless' and accused others of fraud.

'Grenfell demonstrates the existence of a culture of non-compliance within certain sectors of the construction industry. Put bluntly, there is a kind of recklessness as to whether or not compliance is achieved,' said Barwise.

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Spending Review must address net zero agenda

Treasury must focus on six priorities, including training and R&D

The National Engineering Policy Centre (NEPC) has called on the Treasury to focus on six priorities in this month's Spending Review to help it address its net-zero and 'levelling up' agendas.

The group of 43 professional engineering organisations, which represents 450,000 engineers and includes CIBSE, said the government must follow through on its commitment to invest £22bn in R&D by 2024/25. It must also set out substantial increases for the intervening years, along with incentives for the business community to invest in the delivery of net zero.

In addition, the NEPC wants more investment in 'low regrets actions', including low carbon retrofit and refurbishment of the existing building stock, prioritising low carbon heat, such as heat pumps, and

establishing a programme of training and competence in low carbon heat retrofit.

It also advises the government to set up a net zero delivery body to drive and coordinate progress across government and industry, provide systems-level analysis, share learnings about what works, and build a clear, evidence-based vision for a net zero UK. The need to invest in an 'ambitious net zero skills plan' was highlighted in the NEPC's recommendations to the Review and it called for more investment in a long-term Stem education strategy.

The Review should embed long-term demand drivers into decision-making to build back better with low carbon, resource-efficient and resilient infrastructure, the group said, and 'to pivot the UK towards a more sustainable and net-zero future'.

'Front-loaded investment and action will also help to deliver sustainable public finances over the long term,' it added.

Alliance urges action on climate

The engineering alliance Actuate UK has urged world leaders gathering in Glasgow for the COP26 climate conference next month to tackle the climate crisis 'before it is too late'.

The body, which represents eight of the UK's engineering services trade bodies, said the construction industry was committed to helping in the fight against global warming, but leaders must have 'courage and vision'.

It called for the widespread rollout of renewables technology to reduce the carbon impact of buildings worldwide and avoid 'sleepwalking into catastrophe'.

Alan Wilson, managing director of electrotechnical trade association Select, said 'efficient heating and cooling in buildings, improved indoor air quality, and fast vehicle-charging infrastructure' were all within reach, and 'can bring about change if we are bold enough to make them happen'.

'To achieve the demanding net zero reductions they aspire to, it is vital for leaders at this upcoming summit to understand what it takes to turn their vision into a practical reality,' said BSRIA chief executive Julia Evans.

'Together, we must tackle the climate crisis before it is too late - and that means cooperating and collaborating like never before to find real and practical solutions to reducing the carbon impact of buildings across the world.'

Quota system could lead to surge in cheap heat pump imports

UK manufacturers are worried that the government is planning to include sales quotas for heat pumps as part of its delayed Heat and Buildings Strategy. They believe this will lead to a surge of 'cheap, overseas imports' that would threaten British jobs and result in consumers being sold substandard products.

Mike Foster, chief executive of the Energy and Utilities Alliance trade body, said a plan to impose a 'market mechanism' as part of the strategy would lead to 'Soviet-style production planning' and penalise UK boiler manufacturers if they fail to hit sales targets.

'Anecdotally, we hear of Chinese heat pump manufacturers approaching UK firms with a view to selling cheap appliances for them to badge, so they can meet the Whitehall-imposed production quota,' he said. 'Our members, who are facing a financial penalty if they don't supply the market with enough heat pumps... may end up bringing these cheap imports into the UK or paying a fine if they don't.'

Foster said it was wrong to try to force products onto the market 'regardless of consumer demand'. 'We risk the heat pump version of the old Lada factories producing lines of poor-quality cars that nobody wants.'

New apprenticeship scheme launched

A government-backed early careers initiative that aims to help people find careers in construction was launched last month.

Talentview Construction (TVC) - supported by the Construction Leadership Council, universities, colleges and construction industry employers, and funded by the industry CITB levy - helps candidates browse opportunities by signing up to alerts for job and training opportunities and building their own online profile so employers can find them more easily.

Employers can use it to showcase their business to talented new recruits on the TVC site, and upload all their early career vacancies, including traineeships, apprenticeships and graduate jobs. They can also search for suitable candidates and directly contact students and apprentices, as well as connecting more closely with schools, universities and construction colleges.

It is estimated the construction industry needs to recruit more than 217,000 new workers between now and 2025 to support its current activity, including the development of new careers in digitalisation and sustainability.

However, careers advice to young adults is falling behind industry needs. Just 16% of respondents to a recent Office for National Statistics survey said they had received any information about the wide variety of careers in construction and the built environment when they were at school or college.

IN BRIEF

Research to tackle net zero barriers

The Scotland and Northern Ireland Plumbing Employers' Federation (Snipef) has secured funding for research to help the industry overcome barriers to net zero.

The Construction Scotland Innovation Centre is providing the funds, and Snipef will work with the University of Edinburgh and the Energy Saving Trust on the project, Marketplace Demand and Pathways to Engagement for Net Zero Skills.

The research will seek to highlight the importance of the plumbing and heating industry in the journey to net zero.

Young Engineers Awards shortlists revealed

Twenty apprentices and graduates, and six firms, will be contesting this year's Young Engineers Awards.

The shortlist for the virtual awards, which take place on 14 October, has eight finalists in the CIBSE ASHRAE Graduate of the year competition and 12 in the Apprentice of the Year award (see page 22).

This year's awards include separate recognition for Apprentice of the Year – Technician (Level 3-4), and Apprentice of the Year – Degree (Level 5-7).

The Employee of the Year finalists will be announced at the same event (see page 13).

The awards are delivered in partnership with CIBSE Patrons and are sponsored by Ideal Heating, ACV and Swegon. To register for the awards, visit www.cibse.org/YEA

Alan Sherratt dies aged 85

Founder and director of the Mid-Career College, and coordinating editor of the *International Journal of Ambient Engineering*, Alan Sherratt has died at the age of 85. He wrote textbooks on the integrated environment, air conditioning design, heat pumps, and energy management, and was awarded the CIBSE Barker Silver Medal in 1988. He became an honorary member of The Rumford Club in 2004.



Record infrastructure plan will need 'colossal' skills drive

Scheme could lead to opportunities boost for apprentices and graduates

The government's announcement of a record £650bn investment in infrastructure projects over the next decade will be a massive boost to the building services sector, but will need to be matched by an unprecedented surge in training and recruitment, according to the Building Engineering Services Association (BESA).

A mixture of public money, private sector investment and the recruitment of more than 425,000 skilled workers is proposed to deliver the updated Infrastructure Pipeline plan published this week. More than £30bn worth of social and economic projects are due to be launched this year, according to the Infrastructure and Projects Authority, as part of an overall £200bn of work underpinning the government's Build Back Better programme.

Transforming infrastructure performance:

roadmap to 2030 lays out a detailed plan that could lead to a surge in new opportunities for apprentices, graduates, and experienced workers with the right skills, according to BESA.

Transport, energy and utilities will command the largest share of the work, but there are also big plans for social and digital infrastructure between now and 2025. The contracts are worth between £15.4bn and £22.4bn, and 170 will need to be delivered by making best use of modern methods of construction (MMC), according to the Infrastructure and Projects Authority.

BESA welcomed the updated plan as a 'vote of confidence' for the sector, but pointed out that the programme relies heavily on improving productivity through greater use of digital technology and innovation. Increasing use of MMC will need to be supported by an upsurge in specific skills, many of which are currently in short supply, the association added.

£270m fund to boost 'green' networks

A £270m fund for low carbon heat networks will open to applications next year, and will take the place of the current £165m Heat Networks Investment Project.

The Green Heat Network Fund is designed to incentivise investment in low carbon heat technologies, such as heat pumps, solar and geothermal energy, as the main energy sources for networks, as part of the government's strategy for decarbonising heat and delivering net zero buildings by 2050.

The fund is designed to deliver up to 10.3Mt of carbon savings by 2050, and the money will be available to both public and private sector developers from next April until 2025.

'The Green Heat Network Fund will allow us to drive forward the new, cost-effective and low carbon technologies we need to kickstart new industries and support new jobs in the low carbon technology sector, as we build back greener from the pandemic,' said energy minister Lord Callanan.

There are currently around 14,000 heat networks operating across the UK, supplying heat and hot water to 480,000 end users. They provide around 2% of national heat demand, and substantially increasing that figure will be crucial to net zero plans, according to the government.



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Working towards a Dark Skies Standard

The UK Dark Skies Partnership (UKDSP, ukdarkskies.org.uk) has published a new guide to improving sky quality by reducing unnecessary and inappropriate light pollution through behavioural change, education and the promotion of environmentally sensitive lighting.

The Society of Light and Lighting is part of the partnership, a collaborative forum of UK dark-sky places, including those with international Dark-Sky Association designations; relevant professional organisations; the Commission for Dark Skies; CPRE, the Countryside Charity; and the Institution of Lighting Professionals.

They support the work of the All-Party Parliamentary Group of MPs for Dark Skies, co-chaired by Andrew Griffith MP and the Astronomer Royal, Lord Rees (appdarkskies.co.uk).

In developing a lighting guide, the group hopes to address local need to landscape impact. Providing advice on domestic and non-domestic lighting, the document:

- Describes the mindset of environmental/dark skies awareness when installing exterior lighting
- Sets basic principles of lighting to a dark-sky standard
- Signposts existing standards, guidance and advice where needed and appropriate.

You can access *Towards a dark sky standard – A lighting guide to protect dark skies: from local need to landscape impact* at bit.ly/CJOct21Sky

BSER&T special issue on fire safety

The *Building Services Engineering Research and Technology (BSER&T)* journal is seeking abstracts for papers on fire safety for a special issue.

It is keen to showcase the latest knowledge and developments in all areas related to building services as an underpinning element of the fire safety strategy.

If you have research or practice in the area of fire safety that is sufficiently robust to form the basis of a peer-reviewed research paper or technical note, *BSER&T* would like to hear from you.

Send an abstract of no more than 200 words to BSERT-Fire@cibse.org by 12pm on 22 October. For details, visit bit.ly/CJOct21BSERT

- For more, see the Q&A on page 20

SoPHE's year in review

The Society of Public Health Engineers (SoPHE) has had a productive year, despite the challenges of Covid-19.

Jack Batley, CIBSE membership services coordinator, gives an overview

SoPHE ensured its members still had access to high-quality CPD throughout the lockdowns and other restrictions. Thanks to Malcolm Atherton, SoPHE Global CPD coordinator and North West representative, it hosted 11 online CPD events, which attracted more than 1,400 registrations.

A range of topics was covered, including: 'What are the key considerations for above-ground drainage systems?', presented by Matt Lightbody, commercial director at Saint-Gobain PAM UK; and 'Vacuum drainage systems – how air can help us save water', by Andrew Hay, of Otter Vacuum Systems.

After a short summer break, SoPHE restarted its regional CPD programme in September, accompanied by further Global CPDs (details will be sent to members in due course). You can access the recordings of previous CPD events at bit.ly/CJOct21SoPHE

The society was also able to operate in person, as restrictions allowed. In July, in collaboration with the SoPHE Industrial Associates Industry Working Group, the society hosted the *SoPHE Plumbing Centre of Excellence Young Engineers Training Day* at New City College Construction & Engineering Centre.

The day was facilitated and organised by SoPHE Steering Committee members Sanjay Modasia, Contractors Group representative; Jonathan Gaunt, past chair; and Peter White, chair. It covered practical skills associated with the installation of domestic water piped

systems, to give young engineers valuable experience of pipework installation to complement their theoretical knowledge.

Attendees were involved in a number of practical CPD sessions with various pipework materials, fittings and valve manufacturers, followed by a team exercise to put their newly learned skills into practice. SoPHE would like to thank New City College and event sponsors Pegler, Abbots Engineering, Ashworth UK and BSS, which also supplied materials and prizes, as well as Chris Snit, for generously supplying the Bursary for the Level 2 first-prize winner.

CIBSE congratulates all those who were elected to the SoPHE, SoPHE Industrial Associate, and SoPHE Young Engineers Steering Committees at the 2021 AGMs, and, in particular, the committees' respective chairs: Peter White, Miguel Garcia and Ben Goodfellow. We look forward to working with them during their term. CIBSE would also like to thank Jonathan Gaunt and Alan Flight for their hard work and dedication during their time as chairs of SoPHE and the SoPHE IWG, respectively. They achieved a great deal, and their effort and resources were invaluable.

After a two-year hiatus, we are excited to announce that the SoPHE London Dinner will take place on 4 November, at the Royal Lancaster Hotel. The dinner will bring together members, industrial associates, and individuals and organisations from across the public health industry. CIBSE would like to thank all the event sponsors, without whom the event would not be possible.

SoPHE has an important and exciting year ahead. If you would like to become involved, sign up as an Affiliate Member at bit.ly/CJOct21SoPHE2 If you have any questions about joining, or wish to learn more, get in touch at sophe@cibse.org



SoPHE YEN group

Employer of the Year shortlist announced

Six forward-looking companies have been shortlisted for the Employer of the Year awards.

Together with Graduate of the Year and Apprentice of the Year, the awards form the Young Engineers Awards, which recognise the best new talent entering our industry and the companies that go the extra mile to nurture them.

The Employer of the Year award highlights the commitment and achievements of employers in supporting and encouraging young people entering the industry, encouraging their growth through training, mentoring and initiatives that place them at the centre of their business. Clear, inclusive strategies for recruiting and empowering young people are at the heart of the companies recognised in the shortlist.

The award is split into small, medium and large employers, and there is an overall winner. The shortlist is:

Small company category:

- EECO2
- Fairheat

Medium company category:

- ChapmanBDSP
- Waldeck Consulting

Large company category:

- ATAL Engineering Group
- Hoare Lea

The awards – delivered in partnership with CIBSE Patrons and sponsored by Ideal Heating, ACV and Swegon – will take place online on 14 October. For details, visit www.cibse.org/yea

The 2020 CIBSE Building Simulation Award was won by Atelier Ten for the modelling of Jewel Changi Airport

Building Simulation Awards open for entries

CIBSE Building Simulation Group launches annual awards

The CIBSE Building Simulation Awards 2021 and the CIBSE Building Simulation Young Modeller 2021 are open for entries.

The awards focus on the use of building simulation in projects and aim to encourage innovation in building simulation techniques.

Entries should provide information on a project that has a simulation or modelling aspect, giving details of why simulation and modelling were important. Entries will be reviewed by a panel of experts, which will select six entrants to present their work at an online event in November, after which the winner will be announced.

The Young Modeller awards recognise the outstanding contributions of young engineers, apprentices and sustainability

consultants working with building simulation, and encompass any type of simulation for the built environment.

The competition is open to anyone who holds a position in academia, industry or the public sector and who is within three years of completing their highest degree, as well as undergraduates, apprentices or those graduating in 2021-22.

Entrants should submit samples of their work, a CV and a referee's testimonial. Entries will be peer-reviewed, and the winner will be announced at the online event in November 2021.

This year, you can register your interest in the 2021 CIBSE Building Simulation Awards by completing a short form ahead of full entry details.

The deadline for entries is 22 October. Enter at bit.ly/CJOct21BSG and watch past events at cibsebsg.blogspot.com

New members, fellows, associates and licentiates

FELLOWS

Jeetun, Ashveen

Central Flacq, Mauritius

Najjar, Mohamed Sami

Amman, Jordan

Rawson, Stephen John

Tadley, United Kingdom

Toolan, Joseph

Leixip, Ireland

Wilson, Leslie Alexander

Auckland, New Zealand

MEMBER

Al-Maani, Bara

Sharq, Kuwait

Bagul, Tejesh

Pune, India

Chatzopoulou, Maria-Anna

London, United Kingdom

Hijazie, Hamza

Auckland CBD, New Zealand

Ho, Hiu Fung

Taipo, Hong Kong

Hong, Sung Min

Oxford, United Kingdom

Huen, Ka Ho

Hong Kong, Hong Kong

Hung, Yiu Man

Kowloon, Hong Kong

IP, Ka Yu

Tsuen Wan, Hong Kong

Kang, Byung Gyoo

Ningbo, China

Khan, Shoiab

Croydon, United Kingdom

Lai, Man Chun

Hong Kong, Hong Kong

Lam, Chak Cheung

Beckenham, United Kingdom

Lam, Hoi Man

Tseung Kwan O, Hong Kong

Lee, Hoi Man

Hong Kong, Hong Kong

Leung, Chun Ki

Hong Kong, Hong Kong

Lok, Chun Hang

Hong Kong, Hong Kong

Low, Cheuk Hang

Yuen Long, Hong Kong

Mahdavi, Ladan

Bristol, United Kingdom

Malhotra, Akshat

Auckland, New Zealand

Nolan, Shane

Dublin, Ireland

Parker, Gary

Keyworth, United Kingdom

Patel, Jiten

London, United Kingdom

Power, Darryn Robert

Cardiff, United Kingdom

Salaima, Mohamad Tamer

Abu Dhabi, United Arab Emirates

Sauhoboo, Mohammad Shameem

Johannesburg, South Africa

Soufi, Mohamad Ghiath

London, United Kingdom

Stanislawczyk, Paulina Edyta

Feltham, United Kingdom

Taylor, Gemma Louise

Lydney, United Kingdom

Thangamani, Hari Krishnan

Dubai, United Arab Emirates

Tse, Kam Chung

Kwai Chung, Hong Kong

Wan, Man Wai Joyce

Kowloon, Hong Kong

Wood, Jonathan James

Abu Dhabi, United Arab Emirates

ASSOCIATE

Atkinson, Chris

Manchester, United Kingdom

Doolan, Adam

Liverpool, United Kingdom

Lee, Ryan

Bexleyheath, United Kingdom

Powell, Ian

Tamworth, United Kingdom

LICENTIATE

Bodilly, Stuart

Weybridge, United Kingdom

Donlon, John

Dublin, Ireland

Dougan, Daniel

Milton Park, United Kingdom

Fujie, Andressa

Dunfermline, United Kingdom

McGovern, Thomas

Liverpool, United Kingdom

Thomson, Douglas

Dalkeith, United Kingdom

Trotter, Mike

Torquay, United Kingdom

Walton, Ryan

Ware, United Kingdom

Making a case

The Health and Safety Executive has published guidance on the safety case principles for high-rise residential buildings set out in the Building Safety Bill, and how to prepare for them. Hywel Davies considers the implications

The Building Safety Bill is now in committee stage, under line-by-line scrutiny. This is the legislation to bring in the most radical changes to building safety law in more than 50 years. As well as creating a new regulatory framework for all building work notified to a building control body, it will place new duties on those responsible for the safety of high-rise residential buildings.

The bill creates a new Building Safety Regulator with overall responsibility for the building control process. Part 4 of the bill creates a new and more stringent regime for buildings defined as higher risk – which the bill defines as being residential buildings more than 18m high or with seven or more storeys.

The regime covers the planning, design and construction of all these buildings. In addition, high-rise residential buildings will also be regulated in operation and will require a safety case report, which must be submitted to the new regulator.

Although fires and serious structural incidents in high-rise residential buildings are mercifully rare, the consequences for people in or around the building can be catastrophic, and a single incident affects many people and their homes.

Grenfell Tower is a stark reminder of the disastrous and tragic results of such incidents. The explosion at Ronan Point, in May 1968, triggered major changes to structural design codes to reduce the risk of progressive collapse. While rare, we must seek to prevent these awful incidents.

The bill proposes a proportionate, systematic and more stringent regulatory approach to prevent or reduce the spread of a serious fire or structural failure. The Health and Safety Executive (HSE) paper *Safety case principles for high-rise residential buildings*¹ gives early insights into the safety case regime for high-rise residential buildings, and outlines the new approach (for England) to manage and control major hazards, defined as fire and structural failure, in buildings.

It defines a major hazard as an event that has the potential to cause significant harm or damage, as well as the risk, or likelihood, of that event occurring. Those responsible for operating and managing buildings covered



“The bill proposes a proportionate, systematic and more stringent regulatory approach to prevent or reduce the spread of a serious fire or structural failure”

by the new regime will need to assess the potential building safety risks in their building, as well as what can be done to reduce the risk of occurrence and mitigate the consequences. It reminds them that they will have to own and manage the risks associated with their building, and will be expected to consider what could go wrong, and what the impact would be.

The main categories of major hazard to be addressed are fire and structural failure, which have the potential to cause a catastrophic and immediate incident and risk to life. This does not mean that other hazards to long-term health – such as damp, condensation and inadequate heating, or overheating in heatwaves that may cause the premature death of vulnerable residents – are not present, but they do not have the potential for rapid and catastrophic injury, damage or loss of life.

The HSE describes what it expects in a safety case report and how it may be presented. There is advice on what is not wanted. Above all, it emphasises the need for those responsible, particularly the Accountable Person, critically to think about each building independently, and not take a template or ‘one I prepared earlier’ approach.

The safety case report must be submitted to the new regulator, who may seek further information and evidence to support the conclusions in the report. They will expect it to be a dynamic case, being used in the day-to-day management of the building to keep residents and other stakeholders safe.

The legislation is still in parliament and may change, and the detailed safety case policy is still under development. There will be more guidance to follow on it and how it relates to other policies, such as the golden thread. But for those who are responsible for high-rise residential buildings, the guidance offers a good start to begin preparing the case that their building is managed for safety.

References:

- ¹ *Safety case principles for high-rise residential buildings: building safety reform – early key messages*, HSE, September 2021, bit.ly/CJOct21HD

Advertising in the *CIBSE Journal*

All advertisements in *CIBSE Journal* should be legal, decent, honest and truthful, and comply with relevant codes of practice, says CIBSE chief executive **Ruth Carter**

CIBSE values its relationships with advertisers that enable it to provide content and platforms to support our members' work, and allow manufacturers and suppliers to engage with our audience. We recognise there are concerns about the accuracy and reliability of some advertising copy currently in the marketplace. So, we have taken the precaution of writing to our advertisers to draw attention to serious concerns in the wider industry about matters emerging from the Grenfell Inquiry regarding the accuracy and validity of product information.

We have noted that additional concerns are emerging in the face of increasing promotional activity relating to devices that claim to 'clean' air and remove viral and bacterial material. In response, we have reviewed our policies, and terms and conditions for advertising in the *CIBSE Journal*, and for promotional activity connected with our events.

All advertisements in our publications should be legal, decent, honest and truthful, and comply with all applicable advertising regulations and codes of practice, including relevant specialist advertising regulations or codes of practice. We, and our agents, reserve the right to withdraw or cancel any advertisement or promotional activity that is reasonably suspected to be non-compliant.

The Construction Products Association has published the Code for Construction Product Information to provide a transparent way to show that marketing material is clear, accurate, up to date and unambiguous: bit.ly/CJOct21CCPI CIBSE expects all advertisers to comply with the code, and has urged them to follow the principles and spirit of the draft document immediately.

The Institution has a duty to consider the safety of the public and to seek, as far as is reasonable, to avoid any association with the promotion of products or services that may not deliver the claimed benefits – and may even have unintended effects for users. We must protect ourselves and our members from the reputational and other risks that may arise from association with advertising that makes unsubstantiated, misleading or false claims about products or services. At the same time, it is incumbent upon CIBSE members to be aware of the dangers posed by misleading product information – wherever it is found or used – and of the need for increased scrutiny of product descriptions.

While we cannot be responsible for the content of advertisers' copy, we are committed to do all we reasonably can to avoid publishing copy that is inaccurate and does not meet the relevant codes.

- A letter has been written to all advertisers notifying them of the updated policy.

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What does zero mean?

The industry needs a clear set of definitions for buildings, and CIBSE Members have two opportunities to have their say, as Julie Godefroy explains

Having a set of commonly agreed, clear and comprehensive definitions for ‘net zero’ buildings is necessary for investment, specifications, trusted and consistent reporting, certification and, ultimately, regulations.

There has been great progress on this in the past few years – first with the UK Green Building Council (UKGBC) framework, and then the London Energy Transformation Initiative (LETI) one-pager on operational carbon (energy use), which is supported by CIBSE. As a next step, LETI and the Whole Life Carbon Network (WLCN) recently produced a full set of definitions, including operational carbon, as well as embodied and whole-life carbon.

CIBSE now has two important opportunities and decisions on which members can engage:

CIBSE – LETI FAQ on definitions

The LETI-WLCN definitions provide principles, but it is difficult to cover, in a succinct and clear way, the range of situations that a building and its energy supplies may face in practice. CIBSE will now be working with LETI to produce a set of FAQs on these definitions, to support clients and project teams, and bring consistency in how definitions are applied. Clarifications will be provided, along with illustrations of a range of situations.

Some examples of what the FAQs will cover are provided below. They focus on the definition for a ‘carbon – operational energy building’, which currently reads ‘one where no fossil fuels are used, all energy use (Module B6) has been minimised, meets the local energy-use target (for example, kWh·m⁻² per year) and all energy use is generated on or off site using renewables that demonstrate additionality. Any residual direct or indirect emissions from energy generation and distribution are “offset”.’

- The incorporation of energy-use targets in the definition may be queried by some: why is it required if energy supplies become zero carbon? Energy efficiency and demand reduction are, of course, supported by CIBSE, and it is right that they are integral to the definition,



“Should ‘green gas’ tariffs be allowed, as they are for electricity, or would this risk encouraging continued reliance on the gas grid?”

as they are required to support decarbonisation of the energy system, as highlighted by National Grid ESO.

- The definition implies that either the building is supplied by its own onsite renewables, or it uses a Power Purchase Agreement for renewable energy or a ‘green tariff’ demonstrating additionality, with guidance on tariffs provided by the UKGBC.
- Once the electricity grid achieves carbon, this will include nuclear energy – so, not meeting the definition’s requirement for all energy to be from renewable sources. A clarification in the definition is, therefore, required to cover that point. In addition, and assuming that the end point is accepted as carbon, this triggers the question of what happens in the few preceding years: is there a point at which grid electricity is not yet carbon, but is so low carbon that additional renewable capacity is no longer considered beneficial or required by the definition – and, if so, when? Under some National Grid scenarios, such ‘near zero’ content could be achieved in the first half of the 2030s – the not-distant future when planning a building – so, again, a clarification in the definition may be useful already.
- Biomass is provided as an example of ‘residual direct emissions’. ‘Residual indirect emissions’ intend to cover those from the transmission and distribution of electricity, and ‘well-to-tank’ emissions. This needs explaining, with guidance on how to calculate them.
- If hydrogen did become available for use in buildings in the future, the definition’s requirement that all energy should be generated by renewables implies that only ‘green’ hydrogen would be allowed, and all indirect emissions associated with generation, storage and distribution would have to be offset. This needs explaining and, at a future point, guidance given on calculations. Again, this may seem a long way off, but the government’s ambition is for trials at the neighbourhood and village scales in 2023 and 2025 respectively.¹
- How does the definition apply if a building is supplied by ‘green gas’ produced on site from, say, anaerobic digestion? Should ‘green gas’ tariffs be allowed as

DR JULIE GODEFROY
is technical manager at CIBSE

they are for electricity – for example, using the UKGBC guidance on such tariffs? Or would this risk encouraging continued reliance on the gas grid while its decarbonisation is still uncertain?

- How are buildings supplied by heat networks to be addressed, including boundaries for calculations of energy use and carbon offsets, and with networks using varied energy sources?

Some of these themes are complex and not necessarily clear-cut, so we will be looking for opinions on what is the right thing to do to truly support the UK's decarbonisation, as well as technical advice on points of detail.

Should CIBSE adopt these definitions?

CIBSE could decide to adopt the LETI-WLCN definitions. However, engagement with members is essential on such an important topic, to create the best possible set of definitions for us all to work from. So, CIBSE is keen to hear whether members think we should:

- Adopt the current set of definitions
- Adopt them subject to modifications and, if so, which ones
- Create a different set of definitions – probably undesirable when industry needs clarity rather than, say, an engineer and architect working to different goals
- Not adopt any particular definition – again, not an ideal situation if we want to give clear advice on the end goal for building performance.

Tests when deciding whether to adopt the definitions should include:

- Do the definitions support real decarbonisation?
- Are they clear and flexible enough to apply in all possible situations (alongside an FAQ)?
- Do they work in different contexts than the UK?
- Should they be 'absolute' and continue to work until 2050, or should we accept that they may need future revision to reflect a changing energy system?

Have your say

Please send your thoughts on the definitions, the questions above, what you think the FAQs should cover, and what position you think CIBSE should adopt, to the technical team at JGodefroy@cibse.org

Also, look out for events and a survey in the next few weeks, when we will be collating views.

References:

- 1 UK Government, UK Hydrogen Strategy, August 2021, bit.ly/CJOct21JG

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Tracking the gap

The performance gap cannot be closed until designers and main contractors plot the emerging energy and emissions profile of their projects, says Dr Roderic Bunn, who introduces a new tool that aims to do just that

Everyone's talking about operational net zero. It's all over social media – LinkedIn is full of it, along with earnest corporate statements and institutional pronouncements of various kinds. All very worthy. Some of it may even be real. Those of us who analyse the outturn performance of buildings on a regular basis are rather more sceptical. Underperformance is still rife.

Yet the industry talks up net zero as if the performance gap has been closed. Yes, there have been much-needed developments, such as the RIBA *Plan for use*¹ – the RIBA's take on Soft Landings – and the energy-rating scheme for offices Nabers UK,² both of which could be game-changers.

On the other hand, such advances tend to be voluntary and/or too niche to make a huge difference immediately. Even a mature technique such as Passivhaus remains a minority sport in the wider construction game, a clear example of how a conservative, habit-obsessed, delivery-focused industry such as construction avoids doing anything it's not contracted, regulated or insured to do.

While these new developments are vital components of the net-zero equation, we don't have decades for them to take effect. Arguably, we have months to achieve the rapid improvements in building performance needed on all projects – domestic and non-domestic.

We certainly can't rely on a revolution in Building Regulations. In January 2021, the Ministry of Housing, Communities and Local Government (MHCLG) [now renamed the Department for Levelling Up, Housing and Communities] issued its low carbon vision for future homes and non-domestic buildings. It said it will 'examine wider proposals for how to address the performance gap when buildings are designed and constructed, and improve the performance of buildings in operation'. Which is great – but the MHCLG's proposed timeframe? 2025.³

The lack of urgency is baffling, until one realises that the ministry openly states that the much-maligned practice of design-for-compliance is only based on 'anecdotal evidence', despite revelations in the government's own £8m Building Performance Evaluation (BPE) programme that the practice was endemic⁴. It's largely stimulated by the Regulations and, therefore, cemented into employers' requirements and contracts.

So, what needs to be done to get project teams to



"There needs to be a cultural reset: the industry must take custody of outturn performance"

track energy and emissions during procurement? First, there needs to be a major cultural reset: the industry – and its clients – must take custody of outturn performance. That requires professional responsibilities to extend beyond design and delivery and into initial building operation, no matter what the current Building Regulations require and what standard construction contracts stipulate.

This necessitates a commitment to the Soft Landings approach of graduated handover, along with an obligation to conduct performance evaluation and feedback as a standard professional duty. As Chris Twinn says: 'If [a] completed building fails to deliver on our predictions, the whole basis of Paris-proof zero carbon evaporates. No hiding behind some code-compliant prediction with the performance gap. Designers, constructors, and operators will be judged on the actual performance of the buildings they deliver.'⁵

Absolutely. But as it stands, the objectives of Part L compliance-based modelling are very different from those of operational energy modelling. Dynamic simulation modellers employed to perform

calculations against the National Calculation Method are not required to have expertise in building performance analysis. They are usually too detached from the project team. They also often lack the experience to reflect the diversities and orders of magnitude that drive up a building's operational energy consumption and emissions beyond the notional values used for regulatory compliance. Typical factors that may raise energy use by orders of magnitude include higher system operating hours (particularly outside of normal operating parameters), higher fabric air leakage than assumed at design, shortcomings in commissioning, and poor system control.

On top of all that, the duties under which energy modellers are typically appointed may not include detailed modelling until RIBA Stage 3: Spatial Coordination. If detailed modelling is required in RIBA Stage 2: Concept Design, concept options would need to be narrowed much earlier to enable a design team to generate robust calculations. That's not the norm.

For these reasons, the use of compliance models to benchmark in-use performance is inappropriate, and their general lack of use after a Building Regulation UK Part L report submission means opportunities for reductions in operational energy and emissions will be

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is a building performance specialist, Soft Landings consultant and associate with engineering consultancy WMEboom

missed. For those opportunities to become known and potential improvement interventions identified, outturn performance must be visible to the whole project team at key points throughout procurement and delivery, not just during design. Assessments also need to be continued after handover so in-use performance can be compared against expectations of the final developed model.

The emerging operational performance also needs to be made explicit and visible to clients, their advisers, and decision-makers, some of whom who may not be technically literate. An emerging energy-performance gap cannot be hidden in arcane numbers. It must be simple, clear and graphic, and, therefore, actionable.

Help is at hand. As part of a project for the Centre for Digital Built Britain, host of Government Soft Landings⁶ (the central government equivalent of the Soft Landings Framework), the author and John Field, director of Native-Hue, have developed an Excel-based spreadsheet that aims to provide the functionality for assessment of operational energy and carbon dioxide emissions as a project progresses through delivery and into operation. Called the Operational Energy and Carbon (OpEC) spreadsheet, it is designed to track changes to power loads (see page 34).

Until we start tracking operational energy as a norm on all projects and use that to inform sensible decisions, the vast majority of new and retrofit construction projects will persist in delivering less than they promise.

I accept that many things have to change for compliance at design to graduate to compliance in use. Appointments, the contracts, the commissioning programmes, what constitutes Practical Completion (particularly its legal status), project insurance, payment regimes, and project budgeting all need an overhaul. The structures we use at the moment work for delivering a net-zero asset – with regulatory sign-off at design – but simply don't work for ensuring performance outcomes, whether covered by guarantees or not.

Even if we manage to revolutionise compliance, clients also need to professionalise themselves. Their influence on ultimate outturn performance can be as great as that of a delivery team. Arguably, higher professional standards are needed for those who procure buildings. As the architect Bill Gething once said, construction has to become a privilege, not a right. It can't remain a Wild West activity if net-operational zero is truly the ambition.

■ The OpEC spreadsheet is available via www.cdbb.co.uk

References:

- 1 RIBA *Plan for use guide* (2021). Download from bit.ly/CJOct21RD1
- 2 Nabers UK www.bregroup.com/nabers-uk
- 3 The Future Buildings Standard. Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for non-domestic buildings and dwellings; and overheating in new residential buildings. HMCLG. January 2021. www.gov.uk/mhclg
- 4 Palmer J, Terry N, and Armitage P (2016). *Building performance evaluation programme: findings from non-domestic projects; getting the best from buildings*. InnovateUK. Available from bit.ly/CJOct21RB2
- 5 Twinn C, The realistic route to zero-carbon. *CIBSE Journal*, June 2020 bit.ly/CJOctRB4.
- 6 Government Soft Landings - Revised guidance for the public sector on applying BS8536 parts 1 and 2. DOI: bit.ly/CJOct21RB3

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BSER&T is looking for abstracts for its fire safety special issue



José Torero

Safety first

The CIBSE *BSER&T* journal is seeking paper abstracts for a special issue on fire safety, as honorary special issue editor Professor José Torero, of UCL, explains

The fire safety strategy of a building of any complexity is underpinned by building services. This covers multifaceted subjects, from smoke management systems and the proper design of façade systems, to practical matters such as compatibility between air handling ducts and sprinkler systems. In a 'special issue' publication, the CIBSE *Building Services Engineering Research and Technology (BSER&T)* journal plans to showcase the latest knowledge and developments in all areas related to building services as an underpinning element of the fire safety strategy.

The issue is looking for material that includes: performance-based design principles; smoke management; fire suppression; fire safety management; building façades as they pertain to fire safety; fire safety building regulations; and fire-safe design.

If you have research or practice that could form the basis of a peer-reviewed research paper or technical note, send an abstract of no more than 200 words, by midday on 22 October 2021, to BSERT-Fire@cibse.org

BSER&T will contact you within three weeks of the submission closing date to let you know whether your paper is invited to be developed for the issue. Visit bit.ly/CJOct21BSE for details on research paper and technical note formats, and requirements for written papers.

Why produce a *BSER&T* special on fire safety now?

Fire safety is an aspect of building design and implementation that requires a high level of knowledge, and which has a major influence on building services, as well as many other areas of design. The major problems with building envelopes have revealed this influence and emphasise their complexity. Therefore, it is essential to review the science behind the interactions between building services and fire safety.

How does the industry ensure that buildings are safe and sustainable?

In tackling a problem as complex as fire safety, the industry ensures that buildings are safe and sustainable by means of high-quality design. This can only be achieved by true understanding of the technical issues and, so, these

assurances can only come through an adequate provision of competency.

Are fire safety systems too complex?

Fire safety is extremely complex, but it is not fire safety systems that are complex. The complexity comes through the relationship between the provisions for fire safety and other building components that have other functionalities. The attainment of goals for many other functionalities – such as energy-consumption reduction, constructability and cost – while guaranteeing the overall fire safety of a building is where the complexity lies.

How can fire safety systems be successfully integrated into building systems?

This can only be achieved by ensuring adequate provision of competent professionals who understand the interactions between the systems they are designing and the fire safety strategy.

How profound an impact will the Building Safety Bill have on improving fire safety?

The bill sets out objectives that, currently, we do not know how to achieve – in that sense, it could have a massive impact. It will, in principle, require new science, methods and competencies. The hope is that we recognise the challenge and address them head on, instead of covering our eyes and pretending nothing needs to change. This is where the value of publishing a special issue such as this one sits, helping us to show where there are scientific needs, and delivering paths to resolve these needs.

■ **PROFESSOR JOSÉ TORERO** is head of the Department of Civil, Environmental and Geomatic Engineering at University College London (UCL)

■ *Building Services Engineering Research & Technology (BSER&T)* is one of the foremost international, peer-reviewed journals that publishes the highest-quality original research relevant to today's built environment. Published in conjunction with CIBSE, this journal reports on the latest research, providing a guide to recent developments in the field. It covers the full range of energy and environmental services in buildings, including: heating; ventilation; air conditioning; refrigeration; building electrical services; building acoustics; water supply and sanitation; distribution and supply of air and water; vertical transport; buildings integrated renewables; ground source energy; building systems-related health, comfort and wellbeing; sustainable building systems; and urban heat island. *BSER&T* is available to members at cibse.org/knowledge



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Eight young engineers – vying to become the CIBSE ASHRAE Graduate of the Year 2021 – will take to the virtual stage at the Young Engineers Awards this month, when the Apprentice of the Year will also be crowned



WE ARE THE CHANGEMAKERS

On 14 October, eight young engineers will go head-to-head to try to win the prestigious Graduate of the Year title. Each one will have a chance to impress the judges with a five-minute presentation on the question: ‘What challenges will engineers have to overcome to deliver sustainable and safe built environments for future generations?’

The CIBSE ASHRAE Graduate of the Year accolade, which has been running for more than 25 years, is one part of the Young Engineers Awards. These also incorporate the CIBSE Employer of the Year award, now in its 14th year, and the CIBSE Apprentice of the Year award, which – for its second year – has been split into two categories: Technician Level 3-4 and Degree Level 5-7 (see the shortlist on page 24).

The awards – delivered in partnership with CIBSE Patrons and sponsored by Ideal Heating, ACV and Swegon – recognise the innovative thinking, hard work and skills of graduate engineers, while showcasing employers who are committed to developing and encouraging young talent (read the employers shortlist on page 13).

The 2021 winners will be announced at the virtual awards on Thursday 14 October. To register for your free place, go to cibse.org/YEA **CJ**

CIBSE ASHRAE Graduate of the Year shortlist

1 Jessica Cansian, ChapmanBDSP

Cansian joined ChapmanBDSP in 2020 as a graduate environmental consultant, and has worked on large-scale commercial projects. She is passionate about sustainable engineering, with a particular interest in net zero carbon design, embodied carbon, passive design strategies, retrofit, and user wellbeing. With an interdisciplinary background, she has a Bachelor’s degree in architecture and urban design (Unisinos University, 2013) and an MSc in sustainable building: performance and design (Oxford Brookes University, 2019). Cansian is a registered architect in Brazil and a CIBSE affiliate, currently pursuing her licentiate ship. She recently became a Well AP and Breeam associate, and was a contributor to the London Energy Transformation Initiative 2020 Modelling and Retrofit Workstream.

2 Ella Clark, Aecom

Clark is a graduate mechanical engineer in Aecom’s London office fit-out team. She has worked on a variety of projects in MEP and vertical transportation, leading the design for multiple projects. She also works to support other young engineers at Aecom and mentors schoolgirls interested in Stem subjects.

3 Matthew Dickenson, Aecom

Since graduating from the University of Nottingham in 2019, Dickenson has worked as a graduate mechanical engineer on a variety of mixed-use projects within the Aecom St Albans team. He coordinates events for the CIBSE HVAC Systems Group, co-leads the Aecom Young Engineers Forum, and participates in Stem events.



4 Michaela Lattenbergova, Arup

Lattenbergova graduated from Heriot-Watt University in April 2019 with an MEng, with distinction, in architectural engineering. Shortly afterwards, she joined Arup as a graduate mechanical engineer, and is currently working with the buildings team in the Edinburgh office and the Arup global digital initiative.

5 Niamh Luck, Couch Perry Wilkes

Luck graduated with a BEng in building services engineering from Coventry University in 2021, achieving a first-class degree with honours. Alongside her studies, she works at CPW Birmingham, where she focuses on healthcare projects for the NHS. As Young Engineers Network vice-president, she is involved with CIBSE West Midlands, where she supports those new to the industry through a local network. She participates in Women in Science and Engineering and Stem events at local schools, and aims to show that engineering is an enjoyable and achievable career path for all. Her objective is to showcase that she can be a great engineer, not just a great female engineer, by demonstrating what her engineering can do.

6 Yara Machnouk, Elementa Consulting

Machnouk is an environmental design engineer working in the sustainability team at Elementa Consulting. She joined the company after completing an MEng degree in architecture and environmental design at the University of Nottingham. While exploring many forms of energy modelling and sustainability within building services and design, she has, more recently, been focusing on whole-life carbon assessments and, specifically, the embodied carbon impact of MEP materials.

7 Jonathan Pairman, Red Engineering Design

Pairman achieved a first-class (hons) degree from Southampton University, and is a graduate mechanical engineer in Red's technology team. He designs sustainable solutions, including a research piece on battery technology/smart grid integration for data centres. Inspired by his family history in teaching, he is a Stem ambassador, and created Red's Collaborative Learning Programme to support graduate development.

8 Lucy Sherburn, FairHeat

Sherburn joined FairHeat after graduating from the University of Sheffield with a Master's degree in chemical engineering, with a year abroad. As a graduate engineer, her role involves working on the design and operation of new-build heat networks to deliver cost- and energy-saving improvements. Sherburn is an active member of CIBSE Young Energy Performance Group and Stem.



The eight young engineers hoping to become Graduate of the Year on 14 October



CIBSE Apprentice of the Year shortlist



» Technician Level 3-4

1 Amanullah Amirmohammadi, Cooper Homewood

The 27-year-old junior electrical engineer at Cooper Homewood started his career as an electrician in Sweden in 2015. He then decided to improve his electrical knowledge and chose to continue his studies in electrical engineering.

2 Daniel Bailey, Derry Building Services

Bailey has been working in the mechanical industry since leaving school. He looks forward to his ensuing development as he continues his apprenticeship course at Leeds College of Building, along with his career with Derry Building Services.

3 Stevie Braxton, Briggs & Forrester Special Projects

Braxton is undertaking an apprenticeship at Briggs & Forrester Special Projects. Throughout her two and a half years at the firm, she has experienced work within project management, quantity surveying and estimating, completed a HNC in the built environment, and is coming to the completion of her NVQ.

4 Megan Ganderson, Couch Perry Wilkes

Ganderson started her building services apprenticeship in 2019, at the age of 20. Fast-forward two years, and she has headed up a sustainability project, played a key role in the delivery of a vast and diverse collection of projects, and completed the first year of her Level 4 qualification, with distinctions across the board.

5 Harry Playfair, NG Bailey

Playfair is a building services engineer apprentice at NG Bailey. He started his apprenticeship in 2019, studying a HNC in building services engineering, and is on track to complete with a distinction. He is working on the Manchester Town Hall, the UK's largest heritage construction project.

Degree Level 5-7

6 Katie Baker, Tetra Tech

After a year living and working in Australia, Baker joined Tetra Tech as a degree apprentice engineer in 2019. She has worked on a variety of public and private sector projects, gaining valuable experience in improving building sustainability.

7 Josie Cheeseman, WSP

An apprentice building services design engineer at WSP in London, Cheeseman began her apprenticeship in 2019, after completing her A Levels, and is starting her third year at London South Bank University. She is currently working within the mechanical team.

8 Connor Hanlon, HDR

Hanlon is a mechanical engineer at HDR, studying for his degree apprenticeship at London South Bank University. He is enthusiastic about ensuring the industry continues to grow and encouraging young engineers to enrol on apprenticeship schemes - both endorsing the route and supporting others as part of the HDR L&D committee.

9 Musab Mahmood, Atkins

Mahmood is an apprentice building services engineer at Atkins in Westminster. He started his apprenticeship at 17, completing a BTEC Level 3 and obtaining his EngTech. He is currently in year 3 of his degree apprenticeship at London South Bank University, and aiming for a first.

10 Yogi Nagam, Buro Happold

A first-year apprentice in building services engineering at Buro Happold, Nagam began her career at 25 after working in music venues, festivals and bars. She is excited for the opportunity to work and learn at a world-class engineering company so early in her career, and for the projects to come.

11 Jason Rawlins, Couch Perry Wilkes

Rawlins left the British Army (infantry) and wanted to pursue a career in electrical engineering. He joined CPW as an apprentice at 22, and began part-time study at Leicester College. Although he had limited knowledge of building services when he joined, today - at 25 - he has finished his Level 3 with top grades, as well as the first year of his electrical engineering degree at Sheffield Hallam University.

12 Lewis Ward, Couch Perry Wilkes

A 24-year-old apprentice mechanical engineer, Ward has been at Couch Perry Wilkes since 2015. He has completed both his ONC and HNC at Solihull College, and is currently in his final year at Coventry University.



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RETROFITTING THE GLOBE

The affordable retrofit of 25 historic buildings in Myanmar could form the template for making millions of existing buildings across Asia climate resilient, says Doh Eain's **Beverley Salmon**



Doh Eain is a social enterprise that has been operating in Yangon, Myanmar, since 2017, against the backdrop of opening up the country, and a rise in investment and social mobility. Our vision for the organisation is to support communities and individuals through the restoration of heritage properties and the renewal of public spaces.

Myanmar, today, is at a point of significant challenge. Covid-19 and the February military coup have had a significant impact on the population, and 25 million people – nearly 50% of the population – are predicted to be living below the national poverty line by 2022.¹ The World Bank is reporting that gross domestic product will be at -18% for 2021.

Yangon is a city abundant in heritage buildings. It developed through colonial dominance during the 19th century and, by the early 20th century, was a thriving trading hub. Alongside British colonial architecture, the city boasts mansions, warehouses, public offices and religious buildings built by Gujarati Indians, Baghdadi Jews, Arab Muslims, Christian Armenians, and Chinese people – resulting in an eclectic, diverse and densely built cultural heritage.

In 2005, government administrative functions were relocated to the new capital, Naypyidaw, leaving many large public buildings in Yangon without function and to deteriorate in the challenging monsoon climate and the hot, intense dry season. Some public buildings were reappropriated as housing, either officially or by squatters, and many were left abandoned.

This neglect continues to be a significant loss to the city and includes not just public buildings, but also a vast number of privately owned residential buildings.

It is these buildings that are so characteristic for the historic streetscape in the city centre: 70% of its 6,000 historic buildings are residential.

In Yangon, these residential heritage properties are often inherited, and there is limited family means to maintain them. Private owners of heritage properties struggle to find the resources, expertise or finance to look after their homes, even for very minor interventions and maintenance.

Doh Eain provides design, construction and financing support, connecting owners with tenants and then managing the property while it is rented out.

(See panel, 'How Doh Eain finances building restorations'.)

One aim is to protect Yangon's cultural built heritage, but equally important is the objective to develop a sustainable approach that provides good-quality homes and income for owners, who are often from lower socio-economic backgrounds.

We restore buildings and adapt them to make them safe, resilient and healthy spaces. The interventions that we, at Doh Eain, make are relatively simple: managing airtightness for air conditioning performance while maximising the impact of passive ventilation wherever possible (to make it a viable choice for residents); keeping





Yangon has an eclectic and diverse mix of heritage buildings

large volumes; restoring openings for cross-ventilation; and reinstating or repairing overhangs and other shading devices.

In Yangon, the heritage vernacular (typically) is to render the building externally to protect it from the driving, intense, monsoon rains. Internally, we expose brickwork or add a lime render to allow the walls to breathe.

Modern services and appliances are installed – there are many challenges with water supply and electricity, so automating these services makes them efficient and user-friendly. We also now add double-glazing in our renovations. While this is an established staple

“We advocate for the protection of heritage buildings, but we also advocate for quality restorations to create climate-resilient homes”

globally, it is a challenging product to find in Myanmar because of import regulations. However, with the opening up of the country over the past 10 years there are now options on the market, and some manufacturers exist locally.

The interventions described here are very simple, and certainly not high-tech, but although such renovations can be low-cost from an international standpoint, they are still exorbitantly pricey for low-income homeowners. In addition, typical local owners of heritage buildings do not have access to the heritage or conservation knowledge, skilled craftsmen or finance to make such renovations to their properties.

We advocate for the protection of heritage buildings, but we also advocate for quality restorations to create climate-resilient homes. As part of this advocacy, we carried out a research project – with Statement architects and Beca engineers – to model the impact of the renovations we undertake within Doh Eain, and to better understand the local climate, the challenging weather, and its impact on building performance and thermal comfort for residents.

We were able to demonstrate that, by making these simple alterations to buildings, they perform better, reduce lifetime costs for energy consumption, and create a healthy environment.

Through the research, we analysed three building typologies: an unadapted heritage building (the vast majority of homes across downtown Yangon); an apartment that had gone through a typical adaptation by Doh Eain; and a new build that would be in line with the Myanmar National Building Code (see panel, ‘Modelling of interventions’). The national code currently has minimal requirement for reduced energy consumption, despite advocacy from the Myanmar Green Building Society. New residential buildings are typically single- >>



HOW DOH EAIN FINANCES RESTORATIONS

Doh Eain pays for the restorations of heritage properties and, in return, manages the properties after renovation on a short-term basis (five-10 years). Once costs are recovered, use of the properties is returned to the owners, who may elect to continue with Doh Eain’s management services. When a contract is fulfilled, investors stand to receive internal rates of return of 15% up to 30%, or even higher. So far, early lenders to Doh Eain have received an annual interest rate of 5%.

● For a Cultural Heritage Finance Alliance case study on Doh Eain go to bit.ly/CJOct21SB1 and for its white paper *Impact and Identity: Investing in Heritage for Sustainable Development* visit bit.ly/CJOct21SB2



» skin, concrete-block infill walls and single glazed. In this context, it was relatively simple to model the three typologies to demonstrate the positive impact that simple alterations can make.

One key finding from the research was the impact that the monsoon season has on building performance. In line with theory, the small diurnal temperature range – the variance between daytime temperature and night-time temperature – in the ‘summer’ (monsoon season) showed that thermal mass had the least effect on performance during this season.

No lag time was seen for the adapted building in July and the total energy use was still lower than the unadapted building, both of which are thermally massive. This proved that the additional interventions of insulation and double glazing were the key elements affecting the reduced energy consumption.

The quality of the environments we inhabit are essential for our health, mental health and wellbeing. We now feel this more acutely thanks to the lockdowns



Doh Eain wants to clean-up Yangon's 'trash alleys' and bring community life back to the streets



Brickwork of internal walls are left exposed to allow restored buildings to breathe

and stay-at-home orders we have experienced over the past 18 months. Making small interventions to improve these environments is important, and not just for the money they can save on energy bills.

Combining this with a broader social impact is important at Doh Eain. Our work offers a wider reach to communities and neighbourhoods by supporting the renewal of public spaces through our participatory design approach and community engagement focus.

Access to public space is another core element of improved wellbeing that has been proven during the global pandemic and seen around the world. Millions of people do not have access to private outside space, so public spaces become essential for socialising, having a place to rest, exercise, and play.

Yangon fares poorly in its provision, with just 0.32m² of public space per person. Jakarta has 6m², Bangkok 8.5m² and Paris 30m².

Covid-19 and the military coup have driven us to review what we can and should be doing. Our core areas of focus within Doh Eain – protecting heritage, improving buildings, supporting communities and improving access to public space – are now all the more important in the ‘new normal’.

MODELLING OF INTERVENTIONS

The modelling of unadapted, adapted and new buildings was carried out using E20 Hourly Analysis Software by Carrier, also known as HAP51. The modelling showed the impact the building fabric has on the demand for energy consumption from cooling load to maintain a steady internal temperature at 24°C (with a 1K buffer).

Data inputted was: material data, occupancy, weather data, air-change rates and electrical loads.

The weather data provided temperature profiles for three selected days, which represented the peak days for the months of April, July and December.

For July (monsoon) the energy load range is very low for ‘adapted’. This difference to ‘unadapted’ suggests that it is not the similarities in construction such as thermal mass, which is affecting this difference, but is a result of the additional interventions of insulation and double-glazing.



The impact of supporting owners of privately owned heritage in new areas would be significant. Funding often exists for public heritage buildings, but support to low-income owners is overlooked. The value of the cultural and social impact of these buildings is also overlooked, as is the cost to the climate of demolishing and replacing them.

Using digital tools, we aim to support homeowners and build a community, providing the services to support them and which can connect them to socially conscious renters, travellers and social-impact investors – enabling the protection of heritage, good quality environments, and resilient neighbourhoods for more communities. **C**

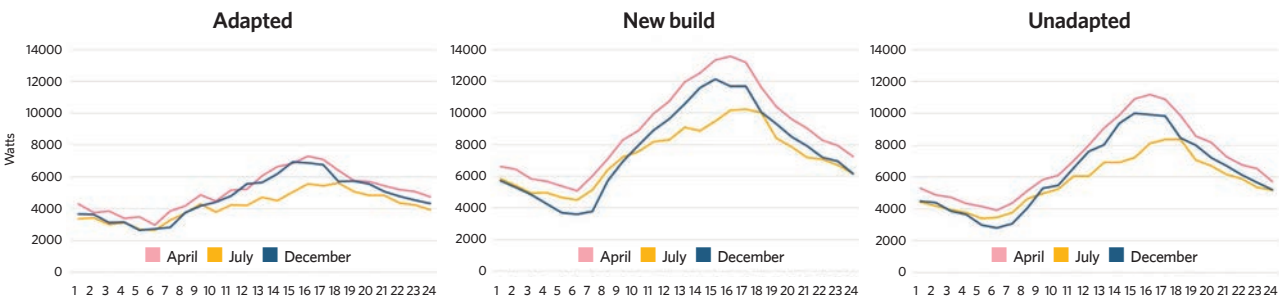
References:

- 1 Covid-19, coup d'etat and poverty: compounding negative shocks and their impact on human development in Myanmar, UN Development Programme, April 2021, bit.ly/CJOct21SB

“We were able to demonstrate that, by making these simple alterations to buildings, they perform better, reduce lifetime costs for energy consumption, and create a healthy environment”

One challenge is to reopen the alley gardens, which have been closed to the public because of Covid and the coup, further restricting the already limited outdoor space that exists within neighbourhoods.

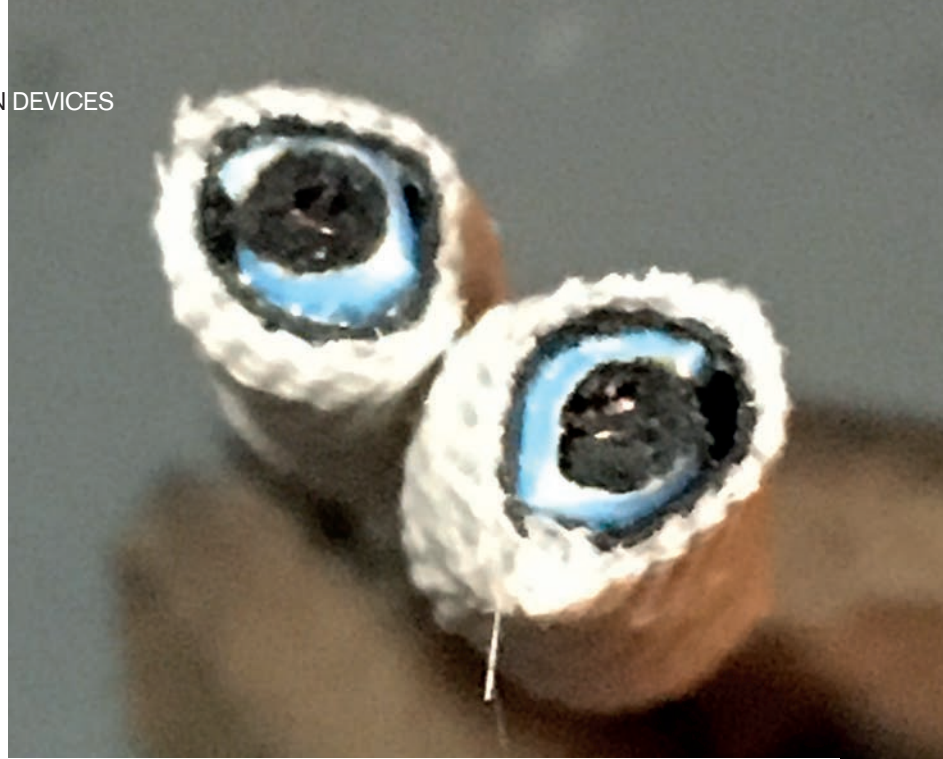
We are investigating opportunities for taking our approach to new countries including Georgia, the Philippines, Indonesia, Thailand and India. We are particularly excited about Georgia as we see many of the same opportunities and challenges we had in Myanmar. Global trends are changing; people do not need to be bound by a single location. There is significant growth in environmental and socially conscious travel, as well as lifestyles, and the tech industry is growing – particularly in Asia – unlocking new opportunities to reach and serve building owners, tenants, guests, investors, and neighbourhoods.



Modelling shows the energy use of the adapted buildings with insulation and double-glazing is lower than that for new-build and unadapted properties

Right: HV-conditioned sample of single-insulated conductor

Arc fault detection devices have been recommended in wiring regulations since 2019. Based on his own experiments, Hoare Lea's **Kenelm Hoare** MCIBSE looks at the realities of arc risk and discusses how effective the devices are in preventing electrical fires



FAULT-FINDING MISSION

After the tragic events at Grenfell, there is an increased emphasis on improving fire safety and, understandably, engineers are looking for technology that reliably reduces fire risk.

Through 2018 to 2019, arc fault detection devices (AFDDs) entered the awareness of electrical engineers and became a recommendation of The IET Wiring Regulations 18th Edition (BS 7671:2018), effective January 2019.

Building on that, the Draft for Public Comment (DPC) for the IET Wiring Regulations 18th Edition Amendment 2 (now closed for comments) proposes a general mandate for the use of AFDDs for most 230V AC circuits.

The decision about whether to follow this recommendation tends to turn on legal and commercial pressure because of AFDDs being recommended by a British Standard. But what

are the technical facts and how effective are AFDDs in reducing the incidence of electrical fires. The following analysis is supported by research and experimentation by the author.

What is an AFDD and how does it work?

IEC 60050 International Electrotechnical Vocabulary defines an AFDD as a 'device intended to mitigate the effects of arc faults by disconnecting the circuit when an arc fault is detected.'

The alternating current waveform is ordinarily sinusoidal, cycling at 50Hz (Figure 1). However, arcing distorts the usually smooth sinusoidal waveform, which becomes 'shouldered'. The shouldering is down to the striking and extinguishing of individual arcs as the voltage wave moves through the zero crossing point (the point where the instantaneous voltage is zero). The arc voltage, the voltage across the spark gap, is also distorted according to the change in impedance (Figure 2).

Such wave distortion and high-frequency noise caused by arcing are parameters that an AFDD uses to identify an arc fault.

What is an arc fault?

IEC 60050 defines an arc fault as a 'dangerous unintentional arc'. This



Development of a series arc fault within a cable sample



is in contrast to arcs that are commonly caused by switches and electric motors through break/make actions, and referred to as 'contact arcing'. These are not dangerous, as they are considered in the design of the equipment.

Arc faults are further categorised as being series or parallel, depending on whether the arc fault occurs in series with the supply or parallel to it.

As parallel arc faults occur between discrete conductors, they usually draw fault currents well in excess of the normal load current (Figure 3). For that reason, parallel arcing can be detected by traditional protective devices.

Series arc faults do not give rise to a fault current and, consequently, are normally considered the most problematic, because they have potential to cause ignition but are not reliably detected by traditional protective devices. Nevertheless, series arc faults emit significant amounts of energy and are capable of igniting cables and nearby materials.

What causes an arc fault?

Arcing requires a gas-filled gap (spark gap) to exist between conductors, such as a broken conductor with air filling the gap between the separated conductor ends.

'Stable arcing', as would be considered dangerous, is very difficult to bring about at voltages of around 230V (root mean square) – the nominal single-phase to earth voltage in the UK. Paschen's Law indicates that, for such low voltages, the spark-gap distance over which arcing could occur is tiny, at around 75µm.

The factor that enables arcing over longer distances and at lower voltages is the presence of carbon at the fault zone. Carbon is a material with thermionic properties, so, when it is heated, it causes the ionisation of the adjacent air, which lowers the voltage at which dielectric breakdown can occur. It is no coincidence that the AFDD product standard (BS EN 62606) uses carbonised polyvinylchloride (PVC) electrical insulation to create arc faults for the verification of AFDD products.

Through experimentation, I found that – with charred PVC close to the fault zone – it was possible to generate arc faults in PVC-insulated twin and earth cabling. By contrast, cross-linked polyethylene does not form char and, consequently, prevented arcing.

Is an arc fault a realistic fault mode?

To sufficiently char PVC insulation to a point where it was conducive to an arc fault, it was necessary for me to condition specially prepared cable samples using a high voltage (around 15 kV). Conditioning resulted in discharges internally to the cable and intense heat at the fault zone that thermally decomposed PVC insulation.

It is difficult to see how similar carbonisation could occur in a realistic scenario without the

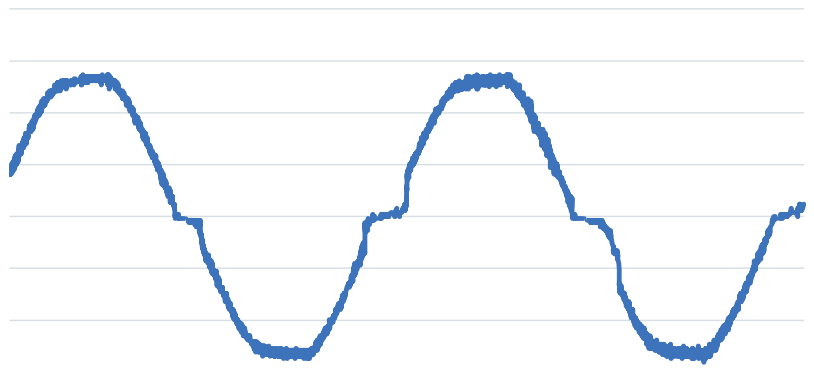


Figure 1: Arc current

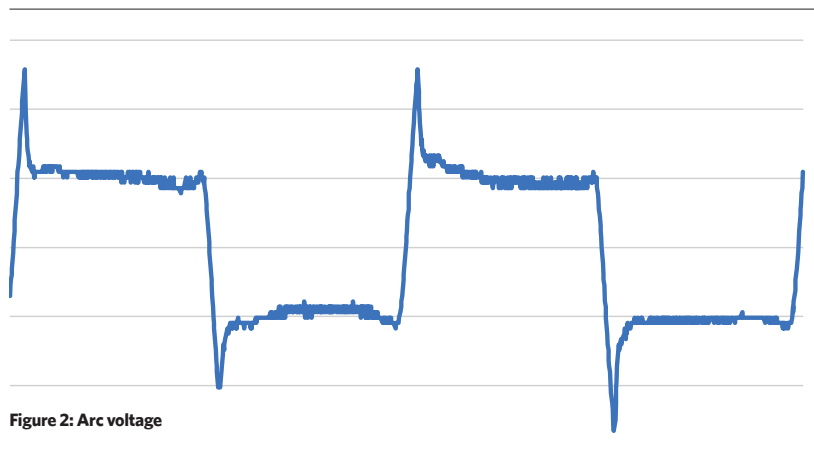


Figure 2: Arc voltage

destruction of the cable because of an external fire. Arc damage to live conductors is a possible outcome of a fire involving cabling, but that is the effect of a fire rather than being the cause of a fire.

While speculation exists regarding the causation and rate of incidence of arc faults within domestic installations, my research and experimentation indicates that arc faults constitute a relatively narrow niche within the band of electrical fault modes.

In reference to being causal to electrical fires, there is no reliable proof that arc faults occur with any significant regularity and it is possible that their rate of incidence is negligible. On that basis, arc faults appear to be a relatively unrealistic fault mode.

Do AFDDs work?

Evidence of their real-world benefit appears absent. To test whether AFDDs could prevent ignition because of an arc fault, I carried out a series of experiments that used the same principles as the AFDD >>

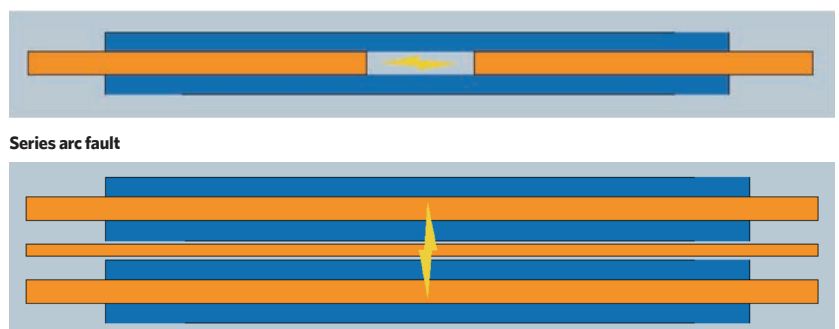


Figure 3: Parallel arc fault



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“Series arc faults are normally considered the most problematic because they have potential to cause ignition but are not reliably detected”

» standard uses in the verification of AFDD products. Using specially conditioned cable samples, I confirmed that, in most cases, AFDDs could detect series arc faults sufficiently quickly to avoid an ignition.

AFDDs were also proven to be more effective at detecting series arc faults than circuit breakers with residual current detection – for example, residual current breakers with over-current (RCBOs). However, RCBOs were also successful in some cases.

While I confirmed the lower threshold of AFDD sensitivity (2.5Amps), I found that arc faults of around 1Amp were not detected. Secondary research also confirms that arc faults of 1.7Amps, and possibly lower, are viable sources of ignition.

While exploring different electrode types, it was noted that where the breakdown voltage was significantly reduced by using carbon rods, the AFDD's detection of arc faults became unreliable.

So, it can be said that AFDDs work reasonably well at identifying arc faults that accord with the fault conditions assumed by the product standard, but they do not prevent all ignitions caused by arc faults.

Will AFDDs reduce the number of electrical fires?

Fire statistics, such as those published by the Home Office, are not sufficiently granular to show any influence from arc faults, and it appears there is little evidence to support AFDDs having much effect on fire statistics. As pointed out earlier, an AFDD will not prevent all ignitions caused by arc faults. Consequently, it is my view that they are not likely to be effective in reducing the incidence of electrical fires.

So, what now?

Clearly, electrical fires remain a concern worthy of our focus. The spectrum of causation to electrical fires is broad, and includes equipment connected to an installation's fixed wiring system. So, for a strategy to reduce the incidence of electrical fires, it should focus on regular inspection and testing, such that – as much as possible – faults are identified before they evolve into fires.

Making such verification work mandatory for all installations in the built environment would be a reasonable measure to reduce the incidence of electrical fires. Legislation requiring this regular verification already exists, including *Electrical safety standards in the private rented sector (England) Regulations 2020*, so its scope could be broadened to include private rented, social housing and owner-occupied housing. [C](#)

■ **KENELM HOARE** MCIBSE is a senior associate at Hoare Lea

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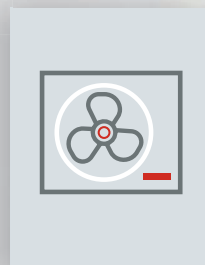
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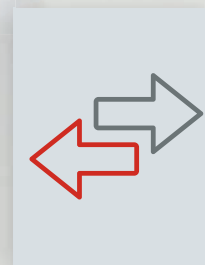
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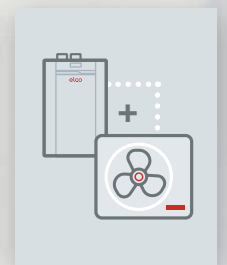
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VISIBLE PERFORMANCE

Making building performance visible is the aim of a new tool that tracks the impact of design changes on energy intensity and cost. **Roderic Bunn** and **John Field** describe the tool and its advantages for use on Soft Landings projects



The performance gap remains a chronic shortcoming in the way we deliver buildings. Clients and builders alike have little idea how a building is likely to perform as it's coming out the ground. Its energy use and emissions cannot come as a shock. The emerging performance needs to be made visible so that corrective actions can be made, or energy penalties accepted.

To help delivery teams tackle this issue, the authors have developed an Excel-based spreadsheet that aims to provide the functionality necessary for the assessment of operational energy and carbon dioxide emissions as a project progresses through delivery and into operation.

Called the Operational Energy and Carbon (OpEC) spreadsheet, the new tool is designed to track changes to power loads. It is part of a project enabled by the Construction Innovation Hub (the Hub) and defines operational energy and carbon dioxide emissions information exchanges for Government Soft Landings (GSL) and other soft landings projects.

The OpEC is, essentially, a more powerful version of *CIBSE TM22 Energy assessment and reporting methodology*, a spreadsheet method originally developed for post-occupancy evaluation. It is also consistent with the energy analysis conventions of *CIBSE TM54: 2013 Evaluating operational energy performance of buildings at the design stage*. Power estimations made using the TM54 approach can be used to populate the OpEC spreadsheet. Thermal loads, typically calculated in dynamic simulation models (DSM), can be imported and updated as required.

What make the OpEC tool particularly powerful are its programmed

macro functions. These enable each iteration involving a change to a load and its operating parameters to be saved within the memory of the spreadsheet. Changes can be recorded in one spreadsheet rather than being dispersed over several files. Each change is captured individually, and the energy saving (or penalty) of a change is summarised in terms of kilowatt hours, kilograms of carbon dioxide, and energy cost (based on a user-selected unit cost of electricity, and fossil gas or biofuel as appropriate).

Figure 1 is a snapshot of how this works. In the example, a project's power loads have been input as single-line entry items. Where a modification to an entry is needed – for example, as information becomes available on the actual wattage of an installed product or its usage factor – the user can record the different value using a 'change' macro function. The cell value is subsequently modified and recorded as a colour overlay unique to the cell.

Changes to the spreadsheet can be on rated wattage, and in-use and out-of-hours usage factors. Hours of use and days per week in use can be altered for individual loads.

All changes to installed loads (kW), hours of use or intensity of use (kWh) and cost (p/kWh) during subsequent project stages can be tracked and reported as changes occur. The iterations are automatically captured in tables, histograms and line graphs (see Figures 2 and 3). Even though a high number of iterations can be recorded in the OpEC tool, the file size will never get bigger than a couple of megabytes, which can't be said of a DSM. Unlike DSM, the OpEC tool does not require a high level of skill; many functions and outputs are automated.

Alterations to loads in the OpEC tool

"The OpEC tool enables penalties to be made visible to all, so they can be accepted or quickly reversed"

Energy Loads Table						Usage data		Results			
Row item	Load type	End-use item <i>(Select from)</i>	Number	Unit or m ² area	Rated Watts m ²	Load factor "in use"	Load factor "out of hours"	Annual energy use (kWh p.a.)	Annual cost of energy (£ p.a.)	% of total cost	Emissions (kgCO ₂)
5	Electric cooker 2				1,000	20.0%	0.0%	990	£99	1.7%	188
6	Grille oven				1,100	20.0%	0.0%	1,476	£148	2.5%	280
7	Extract fans				40	90.0%	0.0%	774	£78	1.3%	147
8	Cooker hood (kitc				900	20.0%	0.0%	346	£35	0.6%	66
9	Breathing building				100	15.0%	0.5%	250	£25	0.4%	47
10	Water heater				2,000	20.0%	0.0%	768	£77	1.3%	146
11	HWS				3,000	70.0%	0.0%	7,056	£709	11.8%	1,341
13	Main hall lighting				40	20.0%	0.0%	664	£67	1.1%	126
14	Classroom lighting (willow) 2 x 28W	Lighting (internal)	16	Units	56	40.0%	0.0%	929	£93	1.6%	177
15	Classroom lighting (Birch) 1 x 35W	Lighting (internal)	9	Units	35	25.0%	0.0%	204	£21	0.3%	39
16	Boiler primary pumps	Pumps	2	Units	800	20.0%	20.0%	1,290	£130	2.2%	245
17	AC Unit	Refrigeration	1	Units	1,290	50.0%	20.0%	3,162	£318	5.3%	601
18	Laptops	ICT	20	Units	200	80.0%	10.0%	6,586	£662	11.0%	1,251
19	Photocopier	Small power	1	Units	1,900	10.0%	0.0%	365	£37	0.6%	69
20	Space heating boilers	Space heating	3	Units	1,200	80.0%	15.0%	14,967	£1,504	25.0%	2,844
21	Fire and security system	Other (Non-regulated)	10	Units	20	100.0%	100.0%	1,747	£176	2.9%	332

Figure 1: Changes to energy loads (single or batched) are saved and assigned a unique colour code – in this case, an increase to an in-use load factor. Up to 15 changes can be captured in a tracked-changes table, which itemises changes to power requirements, emissions and energy costs for each item changed. Additional rows can be added if needed.

Emerging annual energy use in kWh-m² per annum, disaggregated by load, against target/benchmark

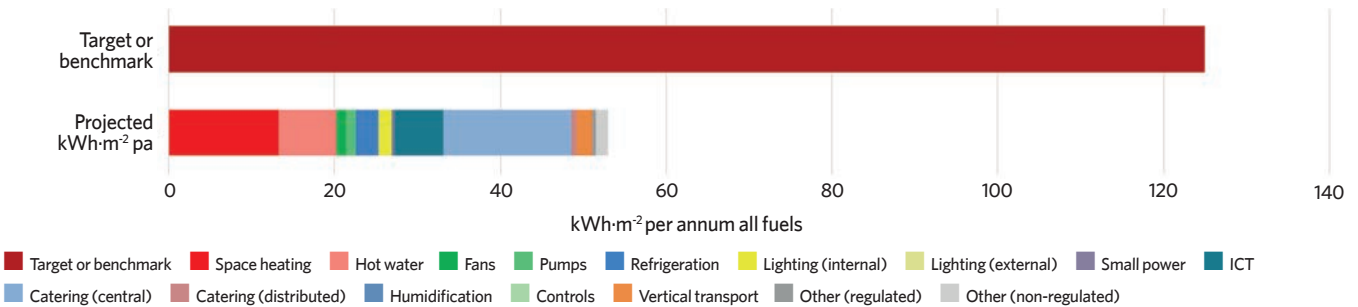


Figure 2: Emerging energy performance is shown as a classic energy breakdown against a benchmark (or design estimation), consistent with energy reporting conventions of CIBSE TM54

that emerge over time (such as during procurement or construction) may stem from a required increase in installed capacity, and/or an increase in planned hours of operation. Changes may also arise from value-engineering decisions that aim to reduce capital costs but result in energy and emissions penalties that would otherwise go unrecorded and unnoticed until the building is switched on.

The OpEC tool enables such penalties to be made visible to all, so they can either be accepted (contributing to an energy performance gap) or quickly reversed. Conversely, improvements to specifications or reductions in a system's hours of operation will be rewarded as an improvement over expectation.

Irrespective of which direction a project heads, the OpEC spreadsheet will record and highlight the cost and energy implications for each iteration. No-one can say they weren't warned or made aware of the consequences of their decisions.

The OpEC tool is particularly appropriate for use on Soft Landings and Government Soft Landings (GSL) projects where operational energy and emissions are required to be tracked during project delivery and into early occupation.

The OpEC tool can be used together with the Hub's GSL frameworks (available at bit.ly/CJOct21RBI). It is a component part of

the Energy and Carbon Reporting Framework covering operational energy and carbon information exchange points (see panel on page 36).

As the developers, we are making the OpEC spreadsheet freely available to all engineers and architects who opt to track operational energy and emissions during a construction project.

OpEC could be a valuable tool until the Building Regulations catch up with net zero aspirations, and until dynamic simulation modellers are freed from the regulatory (and budgetary) constraints of having to deliver compliance models. **CJ**

DR RODERIC BUNN is a building performance specialist, Soft Landings consultant and associate with engineering consultancy WMEboom

JOHN FIELD CEng FCIBSE is director of Native-Hue and head of net zero and compliance at Novus Energy



Percentage change of energy use against base case by change numbers

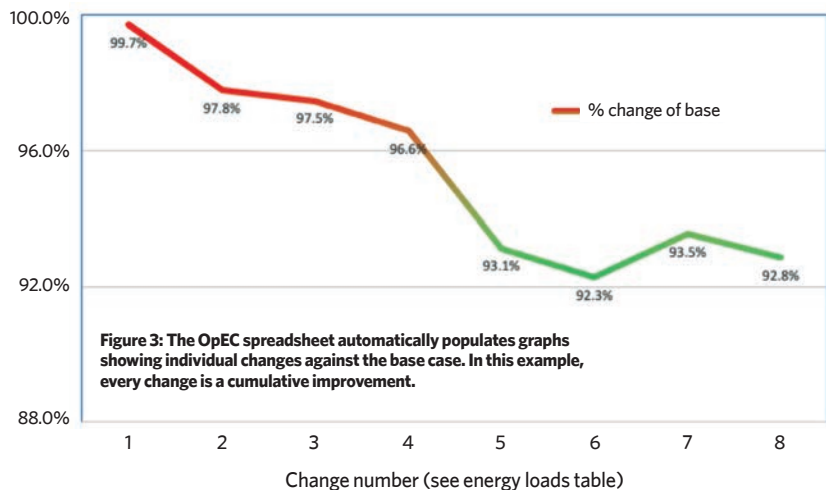


Figure 3: The OpEC spreadsheet automatically populates graphs showing individual changes against the base case. In this example, every change is a cumulative improvement.

OPERATIONAL ENERGY AND CARBON INFORMATION EXCHANGE POINTS FOR GOVERNMENT SOFT LANDINGS

» New guidance, published by the Centre for Digital Built Britain as a partner in the Construction Innovation Hub, defines the information exchange points for operational energy and carbon dioxide assessments, writes James Warne.

The *Energy and Carbon Reporting Framework* defines when operational energy and emissions need to be analysed and reported at key gateways.

The reporting points have been mapped against the gateways of most common project frameworks used in construction and infrastructure projects where powered systems are used, including the 2020 RIBA *Plan of Work*, the BIM Framework (formalised in BS 8536 Parts 1 and 2), and BSRIA BG6:2018 *A design framework for building services*.

The GSL information exchanges in the BS 8536 series effectively act as stage gates – points at which information can be analysed and decisions can be considered based on the information available. The stage gates exist to ensure that projects are validated and controlled properly as they develop.

The guidance also makes reference to the Soft Landings and energy modelling procedures adopted in Scotland, which mandate the use of the *Scottish Capital Investment Manual* and its supporting guidance on energy and emissions.

The *Energy and Carbon Reporting Framework* defines the information requirements at each project stage gateway, largely in accordance with the stages of the RIBA *Plan of Work*. The reporting requirements are supported by flowcharts that show what data and information are required for each gateway.

The flowcharts illustrate the inputs for each stage, including detailed diversity and magnitude factors informed by building performance evaluations and professional knowledge. Flowcharts and supporting

guidance extend beyond handover into the professional aftercare stages of Soft Landings and GSL.

Users of the guidance have two options for assessing an emerging energy and emissions trajectory: in a dynamic simulation model (DSM) or using a simpler spreadsheet-based approach. The choice will depend on the client requirements and the available resources for DSM during the entire delivery period. However, both could be used together, one informing the other.

The resources within the client body for using an inherited energy model to manage in-use energy consumption will also determine the best approach. For most building managers a well-populated operational energy and emissions spreadsheet may be all that's needed.

The Operational Energy and Carbon (OpEC) spreadsheet, described on page 35, is the favoured method of tracking emerging energy use during a GSL project for non-regulated loads.

Although the *Energy and Carbon Reporting Framework* is primarily aimed at project teams adopting the procedures in Soft Landings, it is applicable to all projects where the client requires energy and emissions to be tracked continually. Modelling of a project's emerging energy performance during procurement, design and construction can help a project team keep track of outturn performance and close performance gaps as they appear – and before they become fixed and irretrievable.

The guidance and associated OpEC spreadsheet tool can be downloaded from bit.ly/CJOct21RB1

■ **JAMES WARNE** MCIBSE, is director of engineering consultancy WMEboom

■ The Framework was co-authored by myself and Roderic Bunn, also of WMEboom, with input from industry specialists.

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HOTEL & LEISURE SPECIAL



The multiple benefits of insulating swimming pools
Museum lighting guidance updated for LEDs

BOARDROOM TO BOUTIQUE

Services engineers repurpose East End office for Hyatt Hotels as London begins welcoming back tourists

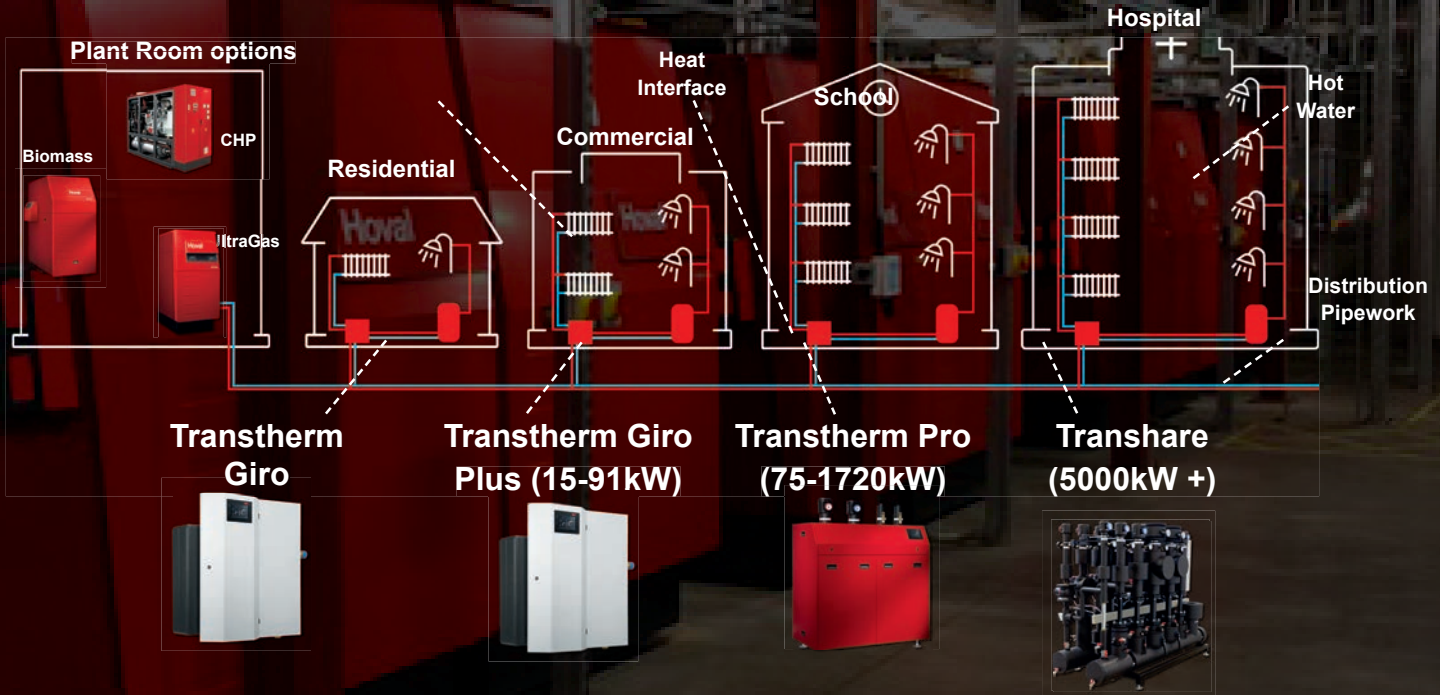


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A sense of repurpose



Perhaps a sign that the tourist economy is reawakening, a spate of London hotels – including The Londoner, in Leicester Square, and NoMad, in Covent Garden – opened this year, showing there is confidence among hoteliers that tourists will return to the capital.

Also opening was Whitechapel Road's Hyatt Place, which has been transformed from a drab, six-storey, 1980s speculative office building into a stylish nine-storey hotel (see page 42). By reusing and repurposing the existing building – a trend that's becoming more popular in light of the growing awareness of embodied energy – engineer ChapmanBDSP used the open-

plan design to its advantage by employing positioning partitions to form the rooms. The transformation was not without its challenges, however, as the ground-floor retail units had to remain open and in operation throughout the project. This meant all the piped services from floors nine down to two, including drainage, had to be routed at high level along the first-floor corridor to one of two existing risers to reach the basement.

As hotels welcome back patrons, focus has turned to the leisure facilities that have laid dormant during lockdown. Our feature on page 48 outlines the business case for improving insulation in swimming pools. This allows them to operate at a higher level of relative humidity – and, therefore, a much lower ventilation rate – without causing condensation.

To account for the rapid evolution of LEDs, the Society of Light and Lighting is publishing an updated guide for museums and art galleries, a preview of which is on page 46.

■ **Liza Young**, deputy editor, *CIBSE Journal*

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Module 186: The importance of optical control for exterior lighting



Welcome back

In transforming a 1980s London office into a stylish hotel, ChapmanBDSP has helped minimise embodied carbon while providing safe, sustainable accommodation for London's returning visitors, as **Andy Pearson** explains





The hotel's ninth-floor terrace offers great views of the City



Black Lion House before its transformation into a stylish hotel

In 2017, Black Lion House was a drab, six-storey, 1980s speculative office building, set above a row of street-level retail units on London's busy Whitechapel Road. Now, it has been transformed into the stylish, nine-storey Hyatt Place hotel, complete with ninth-floor lounge and terrace, with views over the City, a basement lobby and restaurant area, a gym, and 280 guest rooms.

Designed by architect Dexter Moren Associates, the building's remarkable metamorphosis is due in no small part to a clever building services solution designed by ChapmanBDSP.

The engineer's involvement with the building pre-dates the hotel transformation. 'When I was first asked to look at the building, about six years ago, it was to refurbish the existing office for continued use as an office,' says Tom Williams, an associate at ChapmanBDSP.

Back then, there had been a proposal to turn the office into a hotel, but it never materialised. After a change in developer, however, the hotel proposal was back on the table, and planning permission for change of use was granted in 2018. In advance of its transformation, the original office building was stripped back to its concrete structure and three floors added to the roof.

Williams calls the transformation of an office to a hotel 'a great example of the reuse and repurposing of existing building stock', and more straightforward than transforming a hotel into an office. 'This is perhaps the easier of the two options, because an office floorplate is, generally speaking, highly adaptable,' Williams says. 'It's open plan, so there's quite a lot of flexibility in terms of positioning partitions to form the rooms and, I think, you end up with slightly more generous floor-to-ceiling heights.'

One of the biggest challenges in developing the building services solution for this project was that the ground-floor retail units had to remain open and in operation throughout the building's transformation. The hotel's guest rooms, lounge and terrace are on the floors above the shops, while below them – in the basement – is the hotel reception, restaurant, kitchen and, crucially, the plantroom.

'We were putting all these new spaces below ground, but we could only thread the services up from the basement to the first floor using two existing risers in the old office cores,' Williams explains.

Services and fire safety

The guest rooms are serviced with fresh air ducted from two roof-mounted air handling units (AHUs), a roof-mounted hybrid variable refrigerant flow (VRF) system supplies space heating and cooling to a bulkhead-mounted fan coil unit (FCU) in each room, and the bathrooms are served with softened domestic hot water and boosted cold water, which is piped from the basement.

In addition, fresh air is delivered to the guest rooms from the FCU bulkhead, and vitiated air is extracted from the bathrooms via the roof AHU with heat



Right: The basement-level restaurant

“The retail units meant all piped services from floors nine down to two, including drainage, had to be routed at high level along the first-floor corridor”



DRAINAGE SYSTEM

Routing the drainage from first-floor guest rooms, which were located on the floor slab directly above the retail units, was challenging - and ChapmanBDSP's solution was to use a vacuum drainage system.

‘This delivers the soil and waste to high level on the first floor, from where we route it along the corridor and then down to the basement through one of the two cores,’ explains Williams.

The vacuum system is self-contained. It is charged from a unit in the basement, which removes air from the pipework to create the vacuum that draws the waste along the pipe. ‘To maintain the vacuum, you have to use a proprietary WC fitting and an “interface” unit to allow for the connection of any desired hand basins and showers,’ says Williams.

Before specifying the vacuum system, the team visited a number of London hotels that had a system installed, often to help overcome similar constraints.

‘The vacuum system does make a bit more noise than a conventional drainage system,’ adds Williams, ‘but it also uses much less water - so another hotel has put up signs highlighting the system’s water-saving credentials, while mentioning the additional noise.’

» recovery. Wastewater from the hand basin, shower and WC is piped to the basement to a combined outfall for connection to the sewer. The hybrid VRF system features both refrigerant and water.

In simple terms, refrigerant is circulated from the roof-mounted condensers to a distribution box on each floor, which houses a heat exchanger. Water is circulated on the floorplates to transfer the heat and coolth from the distribution box to the FCU in each room.

A hybrid, rather than a full refrigerant-charged, VRF system was used to avoid the need to install a refrigerant leak-detection system in each guest room. Refrigerants are denser than air, so they collect at floor level if there is a leak.

‘For compliance with BS EN378, where refrigerants are present in an enclosed space you either have to demonstrate that the volume of refrigerant charge able to leak into a single room doesn’t exceed a set criterion, or install a significant and costly system that has capability to detect a leak and to pump down the charge from the system to remove it from the unit,’ says Williams.

The hybrid system was also beneficial in developing the energy strategy, which - in combination with a new, high-performance façade - enabled the project to achieve a CO₂ reduction of 45% beyond Part L, as stipulated by the London Borough of Tower Hamlets.

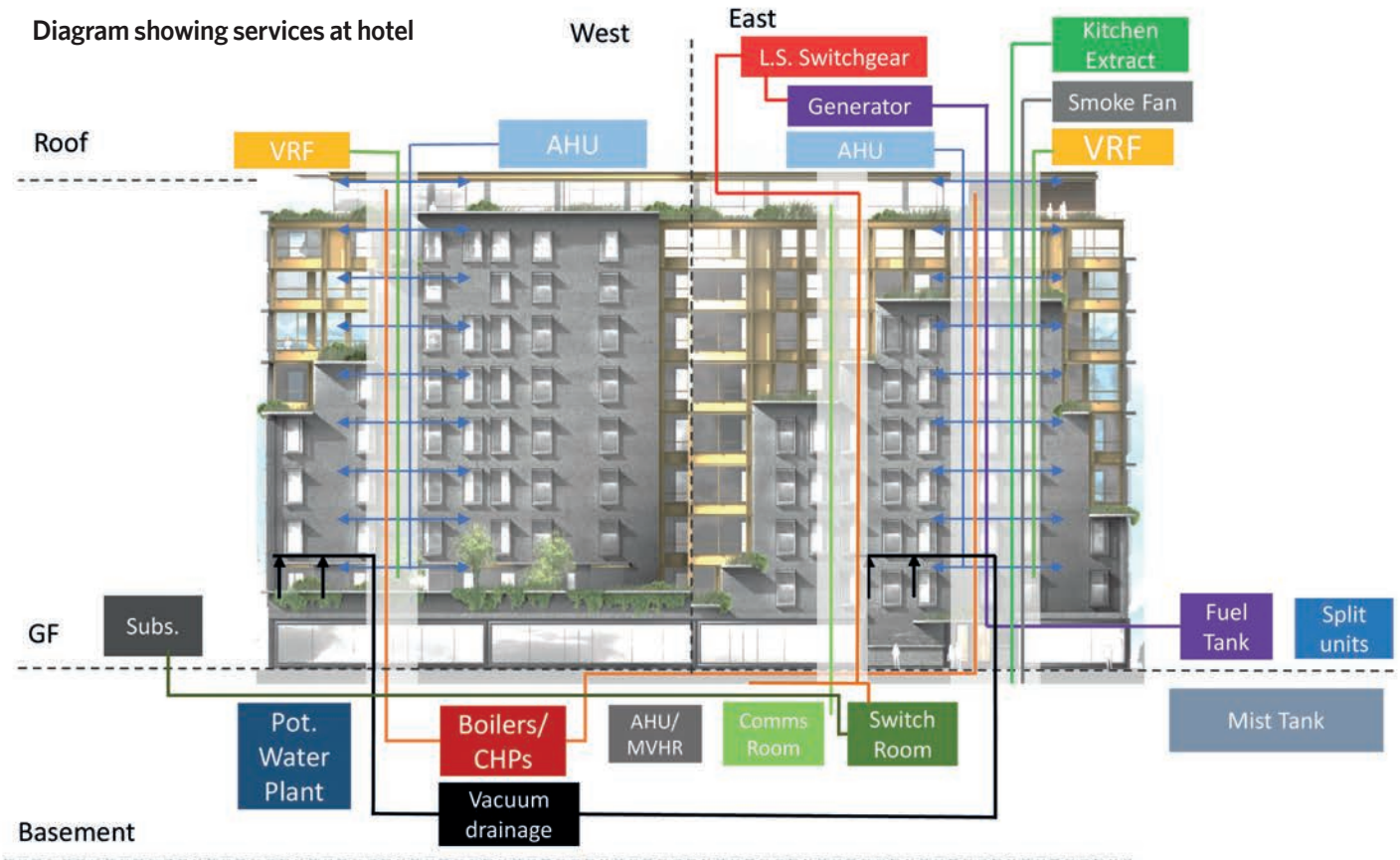
In addition to the inherent occupant safety of the hybrid VRF system, the hotel has a water mist fire-suppression system installed

throughout the building and in each guest room, of which there are approximately 30 on each floor. In a fire, this system uses high-pressure water and a specialised ceiling-mounted sprinkler head to dispense water as a mist of ultra-fine droplets. The droplets evaporate to reduce the temperature of the gases and smoke in room, the radiative heat of the fire, and the oxygen concentration in the zone where the fire and water mist interact.

There is also a benefit from wetting other potentially combustible fuels in the room. Mist systems use much less water than conventional sprinkler systems, which helps reduce the volume of water stored. ‘We opted for a mist system because the office building had not been designed to incorporate a sprinkler system, so fitting a 185m³ - designated as a BS EN 12845 ordinary hazard 3 (OH3) - sprinkler water tank into the basement meant we would have lost about a third of the basement, which had to accommodate the kitchen, restaurant and gym,’ says Williams. ‘The lower water volume has the added benefit for the hotel of reduced time out of operation for repairs if a head were to discharge.’

It was fortunate that, in the existing office, floor slabs had been constructed

Diagram showing services at hotel



in situ, using a hollow-pot system – a method whereby hollow clay pots are incorporated into the floor construction to reduce the amount of concrete used. The pots, says Williams, ‘are relatively easy to remove’ without having a significant structural impact. Accordingly, the servicing solution involved creating a series of vertical service risers aligned with the pots. ‘We took the existing survey information showing where all the pots were located, overlaid the rooms and their risers onto that, and then started to move that jigsaw around,’ says Williams.

The presence of the ground-floor retail units meant all piped services from floors nine down to two, including drainage, had to be routed at high level along the first-floor corridor to one of two existing risers, to reach the 4m-deep basement. ‘When the services get to the first floor, we have had to transfer all the pipework via the two main cores, because we couldn’t run them through the retail units,’ says Williams (see panel, ‘Drainage system’).

In servicing the newly installed upper three floors, the consultant was able to take a more conventional approach to riser distribution. The engineer was able to drop a series of risers down from the roof through the rooms. ‘We created a plethora of new risers to serve the upper three floors to help with the distribution, accommodating fresh air and waste stacks,’ says Williams.

The hotel’s transformation from a drab 1980s office block to a stylish contemporary hotel was completed in June, when Hyatt Place London City East opened its doors for the first time. [CJ](#)



LEDs and the internet of things have transformed specification in the lighting industry, and this has been reflected in the updated *Lighting Guide 8 – Lighting for museums and art galleries*. Guide author **Mark Sutton Vane** summarises the key changes



The art of illumination

The previous version of the SLL LG8, which covers the lighting of museums and art galleries, was published in 2015. However, there have been a number of dramatic changes in lighting technology in the past six years, so an update was required.

Many different professionals, with varying amounts of expertise and experience, are involved in the lighting of museums and galleries. The responsibility for lighting can end up with someone who is not an experienced lighting designer, so this guide aims to help people with all levels of expertise. Hopefully, though, it may make some non-specialists realise they need to employ a lighting designer.

LG8 is not just about museums and galleries, but covers a wide range of building types. It is also about historic interiors, which are displays in themselves. This new version aims to help the lighting designer, or person responsible for the lighting, to emphasise the story, themes or brand of a project, whatever its nature.

As in other sectors, it is the technology of how light is made and controlled that has changed drastically. The 2015 version of the guide still had, quite rightly, much information on tungsten halogen and metal halide fittings, and not as much about LED ones.

At the time, LED technology was in a rapid period of evolution, which made finalising the 2015 edition very difficult. However, the guide

made clear that they were likely to be the principal source of light for museums and galleries in the future – which has, indeed, turned out to be the case.

As tungsten and metal halide sources are not specified any more, all references to those types of light source have been removed from the new guide, and replaced with more detail about LEDs and the technology that exists to support them. This includes information about drivers and dimming.

LEDs have even changed the economics of access for maintenance. As they last so long, some galleries now find it cheaper to hire abseilers to carry out the rarely needed maintenance, rather than have the infrastructure for big, heavy, high-level access platforms.

Another lighting technology revolution that has occurred recently is the development of the internet of things, so this – and various other innovative lighting control and communication systems – are also covered.

While technology has evolved rapidly in recent years, humans and their eyes, and their feelings, have not. Light has not changed. Schemes for museums and galleries are among the most human-centred projects on which a lighting designer can work. So, this guide covers the subjective and human responses to light extensively, and how the lighting designer can influence these responses.

The publication starts with the foundations of lighting design, and explains what light can do and how it can be controlled. This is important, given that some readers will not be lighting specialists. Where museums and galleries are concerned, there are many particular challenges – such as reducing reflections and glare, and getting colours and relative intensities right – that can only be solved if the principles of light are understood.

The three great variables – brightness, colour and direction – are analysed and explained, and the guide helps describe how they control glare, affect the softness of shadows and the rendering of colour.

“It is not the responsibility of the lighting designer to know what an artefact is made of and to decide what light level it can stand”



The Great Gallery, The Wallace Collection, London: the laylight provides much of the light in the gallery

Using these and many other tools, the designer can make lighting emphasise the hierarchy of the story being told by artefacts, the supporting material and the spaces. The photographs below show a typical museum artefact lit from different angles with typical museum light fittings. They demonstrate the huge range of effects that can be created by just altering the brightness or direction of the light.

Museum lighting is rarely a blanket solution. There are often lots of details to solve and the best results are usually only found by experimentation. With this in mind, new sections have been added to the guide about the importance of aiming, adjusting, focusing and setting light levels once exhibits have been installed.

One of the major, perennial challenges of museum and gallery lighting is the damage that light can cause to objects. Light can fade colours and even cause some materials to break down. This is one of the great dilemmas of the museum world. A visitor only knows an object looks beautiful because they can see it. The visitor

can only see the object if it is lit. But that light might be damaging the object and destroying its beauty. That is the challenge of lighting some artefacts: see, enjoy and, so, destroy, or don't see and don't enjoy - or somewhere in the middle, with some enjoyment and an acceptable amount of damage. The guide explains the amount of damage caused by different light levels.

The earlier version listed the amount and type of damage that light does to specific materials, so the designer could work out what level of light a delicate artefact could accept. This is one of the big changes to the updated guide.

It is not the responsibility of the lighting designer to know what an artefact is made of and to decide what light level it can stand. It is the responsibility of the artefact owner to say how much light they are prepared to use to satisfy their decision about the acceptable levels of enjoyment versus damage.

Technology has changed, but how light works, the damage it can do and the amazing effects it can create have remained constant, and are explained in detail. I suspect the reactions of human beings to lighting, involving eyes and hearts, will also remain constant, and these factors are the most important parts of the new version of LG8. **C**

MARK SUTTON VANE FSLL, is director of independent lighting consultancy Sutton Vane Associates and author of *Lighting Guide 8 - Lighting for Museums and Art Galleries*, which is scheduled to be published in late spring.

LG8 is available on the CIBSE Knowledge Portal at www.cibse.org/knowledge



An artefact with lighting from different angles from typical museum light fittings - a 'huge range of effects can be created by just altering the brightness or direction of the light'



Making the case to save energy at a stroke

Improved insulation in wet leisure centres not only cuts heat loss through walls and windows, but also allows swimming pools to operate at a higher relative humidity, resulting in energy savings as ventilation rates are reduced. Dee Associates' **Mike Hancock** explains

People of all ages enjoy going to the swimming pool for sport, therapy and recreation. However, energy use in wet leisure centres and hotels with indoor pools is often higher than expected. This is because a lot of energy is used to heat the pool water to a comfortable temperature, and this gives rise to quite high levels of evaporation into the air of the pool hall. Ventilation is used extensively to remove the damp air and so prevent damaging condensation on cold surfaces, but the net effect is to remove the energy from the building as waste latent heat. For many designers and operators, obtaining the best results is something of a black art.

We became involved in helping to reduce the energy use in leisure centres and swimming pools several years ago. Some were very well run and had the latest equipment, but, in others, we came across a number of common problems.

Very often, the ventilation ran flat out all year round, both day and night. This was generally because no-one understood how to control it and no-one was willing to take the risk of tampering with the settings. Doors and windows were often left open and warm, moist air penetrated well beyond the pool hall.

Pool covers, which are meant to reduce evaporation overnight, were not used, and heat-pump energy-recovery systems remained unrepaired and out of service.

We witnessed numerous cases of CHP engines either broken down and abandoned, or requiring heat to be discharged from rooftop radiator panels in summer to meet contractual operational demands.

Other observations included the relatively poor design and condition of the buildings, especially of older properties, with many showing the ruinous impact of condensation on structural steelwork. Undaunted by the challenges, we decided to try to model them, because we needed to be able to justify, financially, the improvements we were recommending.

Swimming-pool modelling

When we first looked at the pool halls as conventional dry buildings, we found the

conductive heat losses were only a fraction of the total heat input. So, we needed to understand how to account for the majority of the energy use.

We began by researching what had already been done and came across some interesting work carried out by a group of US researchers,¹ who tried to establish the rate of evaporation from indoor and outdoor pools. They took measurements, and related them to the number of people in the pool and the speed and humidity of the airflow over the surface, air temperature and other factors. We built these findings into the heat and mass balances over the pool system.

Our clients were keen to know the implications of any changes on the annual cost of operations, so we represented the resulting output as a set of 'characteristic curves' for any given pool. These show how costs can be reduced by cutting the ventilation rate and allowing the relative humidity (RH) to rise.

The optimum ventilation level is that which is just sufficient to prevent condensation. This varies over time with pool activity and outside temperature, so it is really important that ventilation is varied to meet the changing conditions. For example, the need for ventilation overnight is much less than during peak bathing periods, and higher in winter, when the walls are colder.

These 'characteristic curves' are also very useful in evaluating the annual energy savings from using pool covers overnight, the value of repairing the heat pump recovery systems, and the financial benefits of modern ventilation-control systems.

Ventilation controls

Pools should have variable-speed ventilation systems, controlled in response to humidity levels inside the pool and temperatures outside. These ensure ventilation can be minimised overnight – which is especially relevant if a pool cover is in place – and, at the same time, accommodate the high evaporation levels during busy periods. Seasonal variations in the inside wall temperature also need to be accommodated.

The case for improving insulation

The above characteristic curves do not take into account conductive heat losses through the walls and windows. In the early days, we did calculations to show the impact of improved insulation as if we were dealing with a dry building. Table 1 shows that insulation can reduce the heat lost through conduction (dry buildings) by about >>

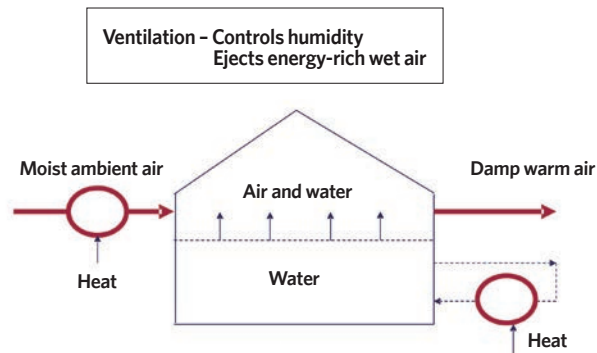


Figure 1: Simple schematic of a typical swimming pool

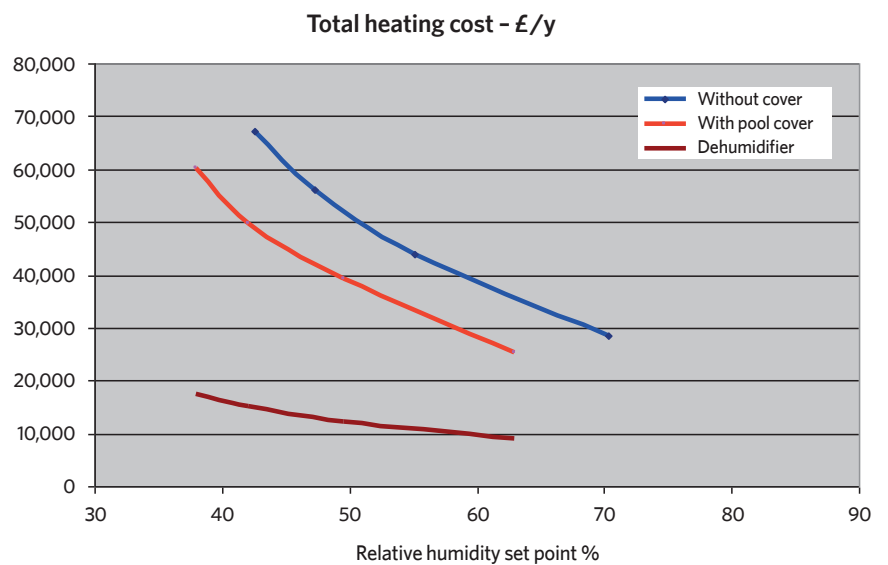


Figure 2: 'Characteristic curves' show how annual gas heating costs can be reduced by operating at higher relative humidity through lower ventilation

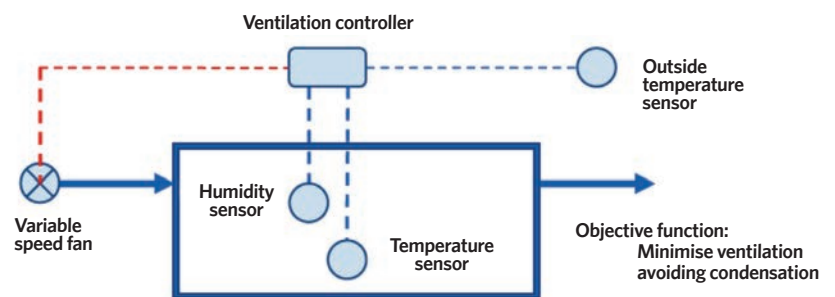


Figure 3: Overview of control strategy

“Ventilation is used extensively to remove the damp air and so prevent damaging condensation on cold surfaces, but the net effect is to remove the energy from the building as waste latent heat”



» 523,000kWh per year, saving heating costs by about £22,300 per year. This is rather small compared with the cost of the work.

Many pool halls are not very well insulated, but the financial justification for installing additional insulation and double glazing is usually not very strong. We came to realise, however, that improved insulation would have a dramatic secondary effect. Better insulation allows the pool to operate at a much higher level of RH and, so, with a much lower ventilation rate, without causing condensation.

We can see from the 'characteristic curves' for a typical pool that raising the RH from 50% to 60% saves about £10,000 per year in (gas) heating costs. Our model showed that operating the pool hall at 70%, rather than 50%, would save 550,000kWh per year, worth about £23,400 per year. (At lower outdoor temperatures the RH would need to be lower.)

These savings arise through blowing out less warm, energy-rich air containing all the latent heat of the evaporated water. This effectively doubles the financial case for insulation. Figure 4 shows the hypothetical temperature profiles across the pool-hall wall with and without insulation.

When we looked at the temperature profiles through insulated walls, we could see that such a rise in humidity levels is possible. So, the energy savings achievable from insulation could be roughly double the savings in conductive heat losses alone.

This makes the case for improved insulation and double glazing much more attractive. It also highlights the need for new buildings to be very well insulated, and have no thermal bridges, exposed steelwork or crevices where condensation can accumulate.

Table 1: Conductive heat losses – typical and good practice

Envelope material	Thermal transmittance $W \cdot m^{-2} \cdot K^{-1}$	Area m^2	Heat loss kW	Annual heat loss kWh per year
Solid brick	2.00	672	26.9	
Single glazing	5.80	168	19.5	
Concrete roof	1.00	800	16.0	
Concrete floor	0.70	800	11.2	
Total			73.6	644,736

Typical practice

Envelope material	Thermal transmittance $W \cdot m^{-2} \cdot K^{-1}$	Area m^2	Heat loss kW	Annual heat loss kWh per year
Insulated cavity	0.25	672	3.4	
Double glazing	1.90	168	6.4	
Insulated roof	0.25	800	4.0	
Insulated floor	0.16	800	0.1	
Total			13.9	121,764

Good practice

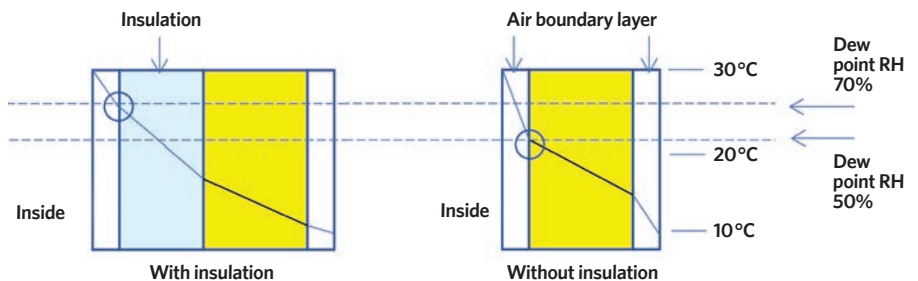


Figure 4: Temperature profiles with and without insulation

“It highlights the need for new buildings to be very well insulated, and have no thermal bridges, exposed steelwork or crevices where condensation can accumulate”

Summary

Modelling has shown that most of the energy used is extracted from a pool in the ventilation, and the more this can be reduced without condensation taking place, the better. The positive impact of pool covers, deployed overnight, has also been demonstrated.

Modelling has highlighted the enormous variation in the evaporation rate during the day and throughout the year, and that a variable-speed ventilation system is needed to accommodate it.

However, the important point is that the best results will arise when well-designed ventilation systems and controls are combined with good building insulation. **CJ**

■ **MIKE HANCOCK** is a director at Dee Associates

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1 Charles C Smith, George O E Löf, Randy W Jones, *Rates of evaporation from swimming pools in active use*, ASHRAE Transactions 1998 vol 108, pt 1, item 4146, pp1-9, American Society of Heating, Ventilation and Air Conditioning Engineers, Atlanta, USA.

Eco yoga retreat opts for heat pump

Vaillant aroTHERM plus system installed at off-grid yoga studio

A Vaillant aroTHERM plus system has been specified to provide heating and hot water for a new yoga retreat near Market Harborough, Leicestershire. The studio – a circular, timber-framed, prefabricated modular building, supplied and manufactured by Rotunda Roundhouses – is off the mains gas grid.

Working with Vaillant, Indigo Renewable Energies provided a turnkey heating and plumbing solution, including installation of the heat pump and associated plant, underfloor heating, pipework and controls.

According to Vaillant, the heat pump has a sound output as low as 54DB. Indigo Renewable Energies calculated the amount of heat loss for the whole property, as well as for each room, to inform the size of heat pump required. The Vaillant 5kW aroTHERM plus was specified for heating and hot water and, because occupancy



levels would vary, a Vaillant 45L buffer tank was also installed.

The set-up allows the heat pump to run for extended periods of time to charge up the buffer, from which the underfloor heating draws its heat when needed.

A Vaillant VRC 700 intelligent heating control unit schedules when the heat pump comes on to warm up the buffer and produce hot water. This is stored in a Vaillant 200L uniSTOR cylinder, serving two shower rooms, a bathroom with disabled access, and a kitchen.

Halton provides ventilation for Parisian landmark revamp

Halton kitchen ventilation products have been installed in the La Samaritaine department store in Paris, which reopened in the summer after a seven-year refurbishment.

The store, owned by LVMH, is targeting affluent tourists. As well as retail, it has a boutique hotel that includes a penthouse with its own swimming pool.

Halton designed, delivered, and commissioned the kitchen ventilation solutions for six restaurants, including Le Cheval Blanc, which is headed by three Michelin star chef Arnaud Donckele.

La Samaritaine's steel structure made it difficult to fit the ventilation ducts required for so many restaurant kitchens. So Halton hoods were specified, and these reduced the extracted air volumes by up to 40%, according to the company.

The hoods were fitted with Halton's demand-control ventilation system, which uses sensors and AI to control ventilation rates. It also includes UV-C treatment for cooking grease and odours.



Passivhaus leisure centre on track

A Passivhaus leisure centre and swimming pool has been given planning permission in Staines-upon-Thames, Surrey.

The plans for Spelthorne Leisure Centre include swimming pools, a mini spa, sports hall, studio space, soft play area, and a café.

Van Zyl & de Villiers is providing M&E services for the leisure centre, designed by GT3 Architects. Gale & Snowden Architects is the Passivhaus consultant. The design team aims to reduce energy use by 60% compared with other new-build leisure centres, and halve water use. Micro filtration will provide drinking-quality water for the swimming pools.

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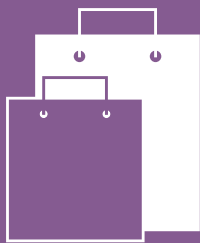


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The importance of optical control for exterior lighting

This module considers how optical performance impacts the implementation of exterior lighting applications

As discussed in *CIBSE Journal* CPD module 173, manufacturers, consultants and contractors will often focus on lamp lifetime and efficacy as the sole indicators of a luminaire's suitability for a particular application. While these are important factors, it is the design of the luminaire and the optical control that can have the greatest impact on performance and suitability for a project. This CPD will explore how optical performance impacts the implementation of exterior lighting applications.

External lighting can greatly enhance the outdoor environment and can extend the use of an area or activity well into the evening, contributing to a real and perceived sense of security at night, enhancing the night-time experience for visitors and residents alike. Urban lighting applications have a particularly important role, not only for safety and accessibility but also by significantly impacting the quality of night-time life for residents and visitors. More broadly, sensitive exterior lighting can instil a feeling of civic pride and may be usefully employed to contribute to the regeneration of urban areas.

Proper optical control is fundamental to ensuring luminaire performance. Optic types will vary depending on the application and any specific requirements of the users and the climate. For internal lighting, diffusers are the most common form of optical control, positioned in front of the light source to deliver specific directional control or to moderate the intensity of illumination. However, diffusers are not typically used for exterior projects. Most external luminaires will include reflectors and lenses, with either a clear glass protecting a lens or simply a flush lens. Lighting designers must choose the correct optical control to suit the requirements of the space and those of the users of the immediate vicinity, and the adjoining, possibly distant, spaces.

As explained by Boyce in the *SLL Guide to limiting obtrusive light*,¹ outdoor lighting that is obtrusive cannot be considered as good quality. Obtrusive lighting exists when people complain about 'sky glow', light trespass or glare caused by the installation. 'Sky glow' is the increase in the luminance of the sky at night above that produced by natural sources such as moonlight. It is diffuse and can affect people

over great distances. Many people complain about sky glow, such as optical astronomers, those concerned with the effect on flora, and members of the public who like to be able to see the night sky. Conversely, it is considered an attribute by some people – for example, in terms of enhancing safety and security; for emphasising the presence of a location or business; or simply by adding to the night-time environment.

'Light trespass' (alternatively described as 'light intrusion', as illustrated in Figure 1) is a local phenomenon where a significant amount of light crosses a property boundary and impacts on the ability of the property owner to enjoy the use of their property – such as where a nearby streetlight shines through a bedroom window. In the UK, light is recognised as potential statutory nuisance in the Clean Neighbourhoods and Environment Act (2005), although some facilities are exempt.

Both disability and discomfort 'glare' may be caused by the brightness of a light source when compared with its background. The fuzzy separation between disability and discomfort glare is such that disability glare can unexpectedly also cause visual discomfort, and discomfort glare may



» (possibly after some duration) impact visual performance. LED lamps generally only emit light in a 180° cone, changing the nature of the optical design from traditional exterior light fittings. LEDs are also much more likely to cause glare than a traditional low-pressure sodium lamp that has a comparably large surface area and optic. Precise optical control is the key element in minimising or reducing glare from small sources such as LEDs.

The impact that the correct optical control can have on these is significant, reducing discomfort, discontent, and distractions for the public, but also limiting the effect of lighting on flora and fauna.

As noted in SLL LG06,³ in addition to the visual impact, there are a number of other aspects that need to be considered in the development of any external lighting design: the creation of a safe and pleasant environment; the appropriate use of energy; ease of maintenance; countering the threat of vandalism; and harmonising the appearance of the lighting equipment with its surroundings. Environmental assessments of lighting systems are necessary to determine environmental performance, reduction or elimination of the negative impact caused by lighting, energy consumption and CO₂ emissions (as well as considering waste management of the lamps and luminaires). The optics of the luminaire will impact the ability to illuminate only areas that are intended, minimising wasted energy and reducing operational environmental impact.

Much of the guidance on the metrics used to select appropriate exterior lighting that avoids obtrusive light derives from the publication CIE 150.⁴ This includes sections that consider the effects and the light parameters for residents (the public), transport system users (including road, marine, waterway and air), sightseers and astronomical observations. It includes useful checklists of considerations that should be included when assessing potential obtrusiveness, and how variations in installation parameters are likely to affect the impact of lighting. To assist in assessing suitability of designs, environmental lighting zones are defined in CIE 150, which are used as the basis of the recommendations in the ILP and SLL guidance (as shown in Table 1).

Issues such as brightness, direction and context need to be considered in the development of the external lighting design to ensure that light pollution and light spill is avoided. The spill of light into areas of nature, such as trees, bushes, plants, and woodland, can cause unknown effects to animals and foliage (as widely reported recently in the popular press, following the publication

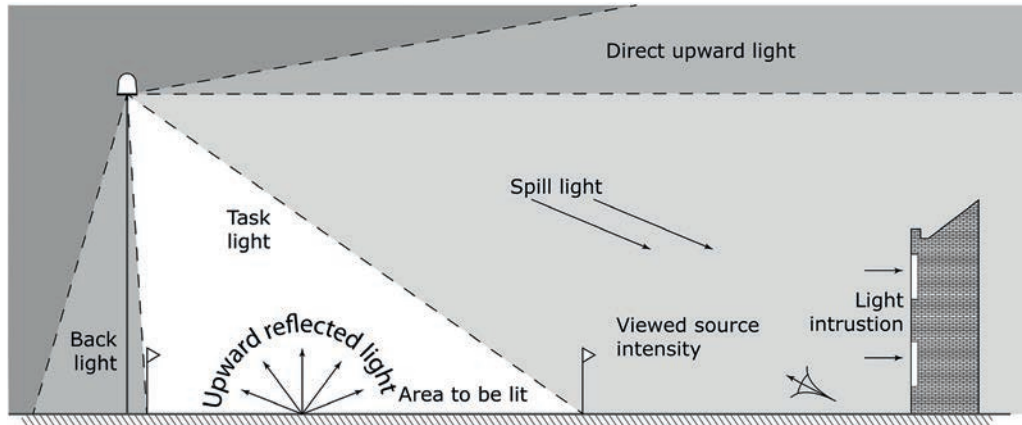


Figure 1: Categories of intrusive light (Source: ILP Guidance Notes 01/21³)

of the paper by Boyes *et al* – see panel ‘Lighting impacts on insects’).

In LG06, it is noted that there is a tendency to choose a luminaire with the highest light output ratio (LOR) on the assumption that this will be the most efficient. This may be an incorrect assumption. Although controlling and directing light inevitably reduces LOR, this would normally light the space more effectively because spill and nuisance light is kept to a minimum. A more appropriate metric is the utilisation factor of the luminaire as it applies to a specific application – that is, the proportion of the luminous flux from the lamp that reaches the desired location. Most outdoor lighting luminaires have optics that develop a bilaterally symmetric distribution, where the light emitted from the ‘left’ of the axis is identical to the light emitted from the ‘right’.³ However, many exterior designs require that light is directed in different directions from each axis. Asymmetrical distribution concentrates the light in specific directions, so as to not illuminate unintended areas with obtrusive light.

Boyce³ notes that, typically, advice given to reduce obtrusive light is to use a fully shielded luminaire, which emits no light directly above the horizontal plane through the luminaire. Fully shielded luminaires normally have the aperture through which the light is emitted sealed by a transparent, flat lens. (Luminaires where the lens drops below the plane of the aperture are not fully shielded and will emit some light above the horizontal.) A fully shielded luminaire may be effective in reducing sky glow but offers no guarantees regarding light trespass and glare. To reduce sky glow, the fully shielded luminaire must be mounted horizontally; however, light reflected from the illuminated surfaces is still likely to be a major contributor to sky glow.

The advice to use fully shielded luminaires considers the luminaire in isolation and not as part of a lighting system. This can be a problem when the luminous intensity distribution of the fully shielded luminaire is narrower than a less-constrained luminaire, necessitating closer spacing between luminaires to achieve the required uniformity of illumination, resulting in a more expensive installation in both financial and energy terms. Optics play a vital role in not only distributing light effectively, but also efficiently. The correct use of optics in exterior lighting will maximise the spacing in between each luminaire. Maximising spacing will reduce cost of the scheme (fewer luminaires purchased) and reduce energy consumption.

Zone	Zone description and examples of such zones
EO ⁴	Areas designated as UNESCO starlight reserves, major optical observatories
E1	Areas with intrinsically dark landscapes: national parks, areas of outstanding natural beauty (where roads are usually unlit)
E2	Areas of ‘low district brightness’: outer urban and rural residential areas (where roads are lit to residential road standard)
E3	Areas of ‘middle district brightness’: generally urban residential areas (where roads are lit to traffic route standard)
E4	Areas of ‘high district brightness’: generally urban areas with mixed recreational and commercial land use with high night-time activity

Table 1: Environmental lighting zones¹

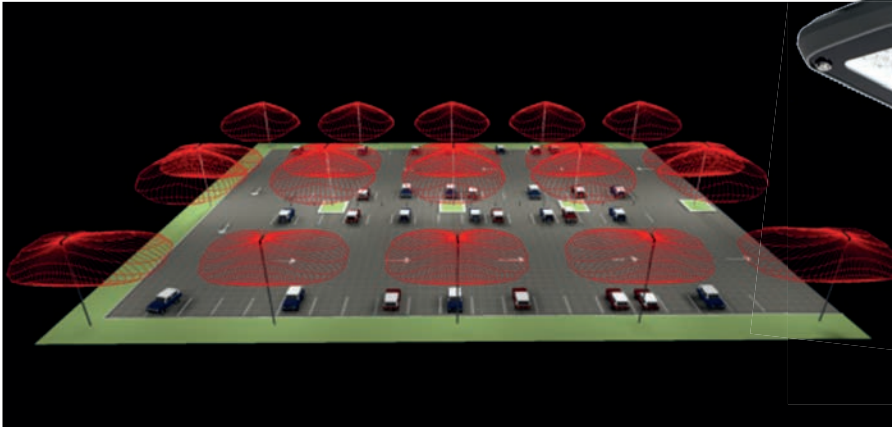


Figure 2: Example scheme for external car park, based on 12m height at 23m x 35m spacings

LIGHTING IMPACTS ON INSECTS

The recent paper by Boyes *et al*^F reports that night lighting has wide-ranging negative effects on insects across their life-cycles, including inhibiting adult activity, increased predation, and disrupted reproduction.

The long-term consequences of light-emitting diodes (LEDs) are still unknown, but it is predicted that white broad-spectrum LEDs have greater potential for ecosystem disruption, based on the visual sensitivities of many taxa, including nocturnal insects. Studies suggest that narrower-spectrum lighting (such as sodium lamps, which emit mostly yellow light) may be less harmful to biological processes.

Optics can also ensure that only the required areas are illuminated, with no backlight or spill (as illustrated in Figure 1). With enhanced illumination control, the space may be utilised more efficiently. For example, BS 5489-9:1996 *Road lighting – Part 9: Code of practice for lighting for urban centres and public amenity areas*⁶ reaffirms that containing lighting within the curtilage of car parks, such as that illustrated in Figure 2, is important for both energy saving and to avoid light pollution. This would require carefully selected luminaires, most with asymmetric optics, with the front glazing kept at, or near, horizontal and so parallel to the ground.

It is important that the form of the luminaire always fits with the character of its surroundings, and to ensure beam angles are set correctly. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In rural areas, the use of full horizontal cut-off luminaires installed at 0° tilt will, in addition to reducing sky glow, also help to minimise visual intrusion within the open landscape. However, in some urban locations, luminaires fitted with a more decorative bowl and good optical control may well be acceptable and more appropriate.

Lighting calculations are invariably performed by software tools. However, the accuracy of the result will be determined by the quality of the input data. Where performance is critical – such as in the avoidance of glare, overspill light or illuminance over a small area – it is important that the original photometry has been measured with sufficient accuracy. Photometric data must be appropriate for the optical combination of light source type, source position and reflector/refractor. If in doubt, ask the manufacturer.

One of the advantages of LED lighting over traditional high-intensity discharge products is that it can be dimmed. Thus, instead of always lighting an empty street



Figure 4: An example of a luminaire with symmetric polycarbonate micro-optic with glass cover that could be employed in the core zone of the car park shown in Figure 2



Figure 3: An example of a luminaire with no backlight that is used on the perimeter of the car park shown in Figure 2

or car park at full brightness, LEDs can be turned down, or off, when they aren't needed and then brought back to full brightness as necessary. This feature both saves on energy and reduces light pollution during the night and at times when lighting must be restricted (often referred to as times of 'curfew').

As noted in SLL LG06, the ultraviolet (UV) radiation in sunlight can have a dramatically detrimental effect on plastics, and polycarbonates can yellow within a short space of time. This is exacerbated where they are used as the front cover of a luminaire, since the yellowing causes the polycarbonate to absorb more heat from the lamp, causing it to degrade even faster. Acrylics, such as polymethyl methacrylate (PMMA), are affected to a lesser extent. Some polymer materials used in outdoor luminaires can 'outgas' for the first few hours of use, causing a film on the cover glass and reflector. This can normally be removed using an appropriate cleaner.

A competent lighting designer, with appropriate experience, will not only ensure an efficient and effective design – so minimising potentially obtrusive aspects – but will also understand the operational requirements of the lighting installation.

The risk of deviating from the specification for lighting designs presents a problem across the whole supply chain and can have a particularly significant impact when considering the design of luminaire optics. Alternative optics may appear similar to those specified by the lighting designer but still not be able provide an equivalent performance. This can easily result in an inadequate solution, as optics are challenging to review based on photometric images. This can subvert not only the intent to provide an effective and efficient lighting solution but also blight a whole development, since the impact of lighting reaches far beyond that of simple illumination.

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Turn to page 56 for references.





Module 186

October 2021

» 1. Which one of these was not highlighted in the article as a potential benefit of external lighting?

- A It can instil a feeling of civic pride
- B It contributes to real and perceived sense of security at night
- C It extends the use of an area or activity into the evening
- D It improves growing opportunity for flora and fauna
- E It may contribute to the regeneration of urban areas

2. Which of the following was not included when discussing obtrusive lighting?

- A Back light
- B Light intrusion
- C Noise/interference from electronic controllers
- D Reflected light
- E Sky glow

3. Which zone description best represents urban residential areas where roads are lit to traffic route standard?

- A E0
- B E1
- C E2
- D E3
- E E4

4. How many luminaires were used in the design illustrated in Figure 2?

- A 6
- B 9
- C 12
- D 15
- E 18

5. Which of these was not included when discussing deviating from the specification for lighting designs?

- A Apparently similar optics will not necessarily perform the same
- B It can blight a development
- C It can subvert the intent to provide an efficient lighting solution
- D It is challenging to determine equivalence from photometric images
- E It reduces the need to use the services of a lighting designer

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STAYING ACTIVE

Smart pump technology and remote-monitoring solutions offer the opportunity to optimise HVAC systems for energy efficiency and cost savings – and could aid design decisions in energy-upgrade projects if implemented early on.

Phil Lattimore reports

The transition to increased remote working since March 2020 has impacted on many aspects of office life, but one trend that has been accelerated by the Covid-19 pandemic is the demand for remote monitoring of HVAC systems to optimise performance and energy efficiency.

For Armstrong Fluid Technology – a manufacturer of intelligent fluid flow equipment, including pumps, valves, heat exchangers and control solutions – interest in its Active Performance Management (APM) suite of remote-monitoring and performance-tracking solutions has grown significantly since the first UK lockdown.

Stephen Hart, UK sales director for Armstrong Fluid Technology, says: 'The market is moving towards more detailed real-time analysis of equipment operating conditions. Being able to see how system components are performing in real time is crucial to reduce costs and improve environmental performance of buildings. Without information on fluid flow across the system, it's difficult to diagnose and optimise efficiency. With accurate flow information, the picture changes entirely.'

A suite of solutions was developed to help optimise HVAC systems at any stage of a building's life-cycle, responding to changing HVAC requirements – including during system upgrades – to improve energy efficiency and reduce carbon emissions.

With the installation in a HVAC system of the firm's Design Envelope intelligent pumps – which feature built-in Wi-Fi connectivity and smart-monitoring capabilities – flow data from a HVAC system can be used with the intelligent software platform to inform a building's energy management team how it's operating. Real-time alerts on the performance of the HVAC system enable them to optimise efficiency and reduce energy consumption while maintaining occupant comfort. The



Cloud-based pump management provides performance reports to system operators

manufacturer claims this can deliver annual energy savings of up to 40%.

Among the options offered in the intelligent software platform is a cloud-based subscription service that leverages smart pump capability to provide performance reports to system operators.

Such monitoring services can also be used to predict and identify potential technical issues that could impact on the operation of the pump – such as excessive vibration, broken couplings, impeller imbalance, bearing failure, seal failures and shaft misalignment – before they become a problem. Packages may be integrated with building management systems, environmental management systems, and computerised maintenance management systems, as well as providing software gateways through APIs and integration with apps and devices.

Information from intelligent software platforms may provide analysis across multiple parameters on single pumps, or aggregated for multiple pumps, offering a scalable solution for new and retrofit applications. The systems are able to provide continuous optimisation and a subsequent reduction in unexpected failures and system downtime. The software can also produce energy-use and environmental-performance data for HVAC systems, to help organisations with relevant environmental reporting requirements.

Upgrade solution

As well as improving building energy management and maintenance for existing HVAC systems, smart pump technology and associated



» intelligent software platforms can also be harnessed for phased HVAC upgrade programmes to improve the performance of the system from the early stages of planning and design, and well before full implementation of new systems.

By installing replacement smart pumps as part of the first phase of an upgrade project – that is, before the usual data-analysis phase and typical discussions about technology solutions and business plan – the systems can collect the detailed and accurate data required for designing the new system.

As well as informing the design of the new system, building owners and occupiers can start saving energy – and operational costs – from the beginning of the project. Building and load-specific information can be obtained via the pump software to identify opportunities for system optimisation with high cost/benefit ratios. This can assist product selection for the upgrade project, while measurable energy savings generated in real time by the monitoring and reporting solution can help demonstrate the business case for upgrade decisions to stakeholders within an organisation. Armstrong claims bringing forward pump-replacement works in the first phase of an upgrade project and installing pumps with advanced performance-management software allows up to 10% of the system energy to be saved ahead of full implementation.

The smart pumps can be selected against the actual installed conditions, and the system recommissioned at the point originally intended by the system designer following a process of opening the system regulating valves and making use of the onboard variable frequency drive to fine-tune the performance of each pump.

For instance, over a six-month period, the embedded software in the pumps would measure pump flow, head and power consumption, and the data used in conjunction with system temperatures to generate a system-specific load profile.

This can then be employed to assist the system designer/client with the selection of main plant equipment and to determine the optimum system modifications that allow for the most cost-effective and energy-efficient system solutions. **CJ**



La Ronda chocolate factory in Dubai uses intelligent control with its pumps

SWEET SAVINGS

Armstrong Fluid Technology's Design Envelope pump technology was used for the cooling system energy upgrade at the La Ronda chocolate factory in the Dubai Investment Park, Dubai, UAE.

The project employed end suction pumps with integrated intelligent sensorless control that included integrated inverters. Each pump has a split coupling, which enables all mechanical seal components to be withdrawn for servicing without the need to disturb other pump components or the motor connection.

The pumps at La Ronda are connected to a proprietary global pump management database, allowing the pump manufacturer to support the local team through performance tracking and alerts to any smart device.

The information provided enables operators to make changes and address issues to optimise HVAC performance. Online trending and analysis across multiple parameters on single pumps, or on an aggregated basis for multiple pumps, assists in identifying performance degradation and facilitates a predictive and proactive approach.

According to Armstrong, in the three-month period after installation, the plant saved 118,355kWh of energy, for a cost reduction of US\$14,633 (£10,708). The installation of the pump solution paid for itself in just seven months, achieving energy cost savings of 90% within 90 days.

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SANITARY CHECK

The pathogens management train has been developed to help identify the risk associated with pathogens in plumbing systems. The seven-stage concept is also designed to ensure sanitary safety in new public health designs, says Buro Happold's **Ashveen Jeetun** FCIBSE



The risks of disease transmission exist at all stages of the plumbing cycle, from connection to the water supply company (WSC) network to the final discharge or recycling. The pathogens management train (PMT) is an innovative, seven-stage concept that can be used to identify the risks associated with pathogens and to increase sanitary safety through careful design. It can also be used to evaluate existing systems to improve sanitary safety.

The transmission of pathogens into the plumbing system can occur by ingress into the system from a contaminated environment, while cross-connection can also be a cause of contamination. Aerosol from odour traps, viral shedding in faecal matter, and/or backflow into the system are other ways that pathogens can be transmitted. Common transmission routes are inhalation, incidental ingestion, dermal contact, ocular, oral mucus membrane contact and faecal-oral. These can occur through direct or indirect contact with contaminated water from the sanitary drainage and/or water supply.

Direct contact can happen when bathing, washing, or drinking contaminated water, while indirect contact occurs mainly through the

formation of bioaerosol from the water supply or sanitary drainage systems. Healthcare sector studies have shown that water inside drainage traps can become contaminated and released into the building through bioaerosol.

The PMT identifies seven stages where considerations should be given: source; storage; distribution; use; traps; drainage; and recycling or outfall (see Figure 1).

Stage one – source

Chlorine disinfection is the most common disinfection system. However, the chlorine is consumed in reaction with ammonia, and organic compounds may be deposited as a result of corrosion and biofilm on pipes' inner walls. Water temperature is another factor that affects chlorine decay, so the free chlorine level in water supplied by WSC varies depending on geographical location.

The suitability of the water quality from the WSC can only be assessed after approved chemical and microbiological testing. Water storage tanks are sized from half a day's capacity to several days, depending on local codes, and the storage period affects bacterial growth in the tanks. The level and method of treatment upstream of the tank relies on the quality of water from the WSC, the period of storage, and temperature. CIBSE Guide G gives a comparison of appropriate disinfection technologies.

Stage two – storage

Water tank storage size is typically based on number of days' demand. In the UK, most tanks are sized at half-day consumption; however, the demand is not the same every day. A school's water storage tank will have more than half a day of reduced consumption over the weekend before normal consumption resumes. Formation of biofilm can occur during these periods. Planktonic cells can develop into sessile cells to attach to the surface of the tank. As colonies mature, detachment of planktonic cells occurs, to contaminate the installation downstream of the tank.

The dimension of a storage tank is usually based on normal demand, but the storage volume of water can be adjusted to actual demand to prevent stagnation. The level can be controlled so that volume stored is based on actual consumption. Level sensors and controllers can be used with the BMS to automatically adjust the level of water based on consumption (see Figure 2).

Stage three – distribution

Aerosolisation occurs when the water in which the bacteria are growing is broken into microscopic water droplets. The emission strength of bioaerosol in high-pressure conditions is statistically greater than that in lower pressure conditions. Research on operation shows that pump sets operate at peak capacity for only 4.5% of the

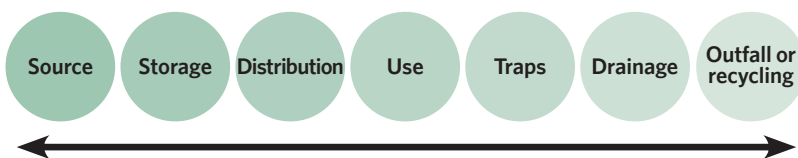


Figure 1: Seven stages of the Pathogens Management Train (PMT)

time. A variable pump pressure setting allows the pump pressure to be adjusted automatically based on demand (see Figure 3). A remote sensor at the end of the index run allows pressure to be monitored in real time and the pump setting pressure adjusted based on a real-time profile.

Pipework is generally designed to serve appliances that are physically closer to the pump, and then towards the most remote point. This can lead to stagnant water when areas of low use are located towards the end of distribution. The system can be designed to serve areas of low usage first, followed by areas of medium and high use.

Stage four – use

Water use in the building is the point where transmission of pathogens from the potable water supply or the drainage is more likely to occur. Bioaerosol is released from drainage traps and water taps each time an appliance is in use. Studies have found that visible light and humidity are factors determining how long the bacteria survive. Humidity control in washrooms and time delay in passive infrared sensors can help in the reduction of bacteria.

Careful consideration should also be given to the location of sanitary appliances. Extraction and drainage appliances can be sited so the air path does not cross users' activity space. The withdrawal of drinking water that is free of pathogenic germs requires the withdrawal point (tap) itself to not be contaminated bacterially.

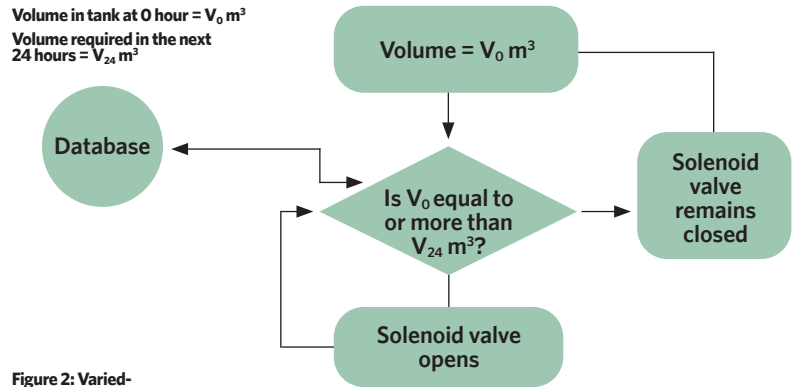
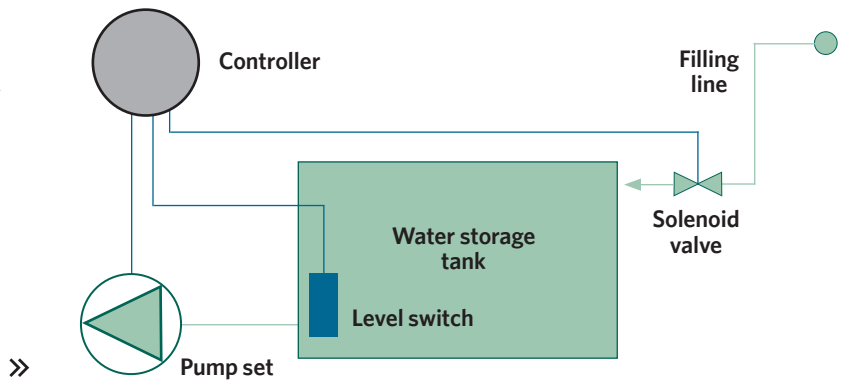


Figure 2: Varied-level water tank



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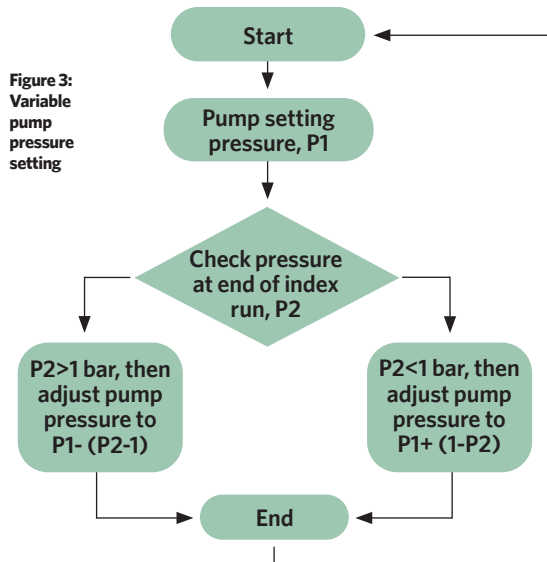
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Figure 3:
Variable
pump
pressure
setting



» Stage five – traps

Biofilm forms, with time, in drainage traps. When water flows through the trap, bioaerosol is released into the room. Pathogens in aerosol can survive and maintain infectivity for several hours. A procedure called 'Find & Kill' can be used to disinfect drainage traps, using a combination of sodium hypochlorite and ultraviolet-C (UV-C) light.

Stage six – drainage

High concentrations of infected people in a building can contribute to a higher microbial load in the wastewater system. Pathogens can be transmitted between rooms or floors of a building through the drainage ventilation system and ubiquitous microbial biofilms in pipes. Disease can spread when traps are dried up because of pressure fluctuations, evaporation, low use of sanitary appliances, or capillary action when not maintained properly. Adequate ventilation should be provided and individual stacks terminated directly on the roof. Avoid a common vent for several stacks. Self-disinfecting traps will stop pathogens in the wastewater pipes from entering occupied spaces.

Stage seven – recycling and drainage off site

Bioaerosol and biofilm from the public sewer can infect occupants, and is difficult to prevent with current technologies. Drainage traps act as the interface between on- and offsite pipework and the building occupants. UVC light, in combination with periodic chemical disinfection, may help, but there is little research. Until products are developed, careful consideration should be given to the design of the building drainage so that bioaerosol is not released inside the building and traps are not depleted.

Conclusion

Designers should consider all possible exposure pathways, while facilities managers must monitor existing buildings and carry out periodic tests to find traces of contamination. Initial evaluation can be carried out using the PMT, and lab tests of water can be performed at different stages of the public health engineering cycle. Based on results measures in the PMT can be used. The PMT is a useful tool to provide a safe sanitary system in new and existing buildings. **CJ**

■ This article is a summary of a paper that was presented at the 2021 CIBSE Technical Symposium cibse.org/symposium

■ **ASHVEEN JEETUN** is an associate public health engineer at Buro Happold

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LIQUID ASSET

Pressure to reduce water use means engineers are increasingly having to incorporate water-recycling systems in their designs. SDS' **Sam Burgess** looks at a greywater on-demand system specified for an upmarket London project

A space-saving greywater on-demand (GWOD) recycling system has enabled a 25-unit housing scheme in London to meet demanding water-use targets, despite the physical constraints of the site.

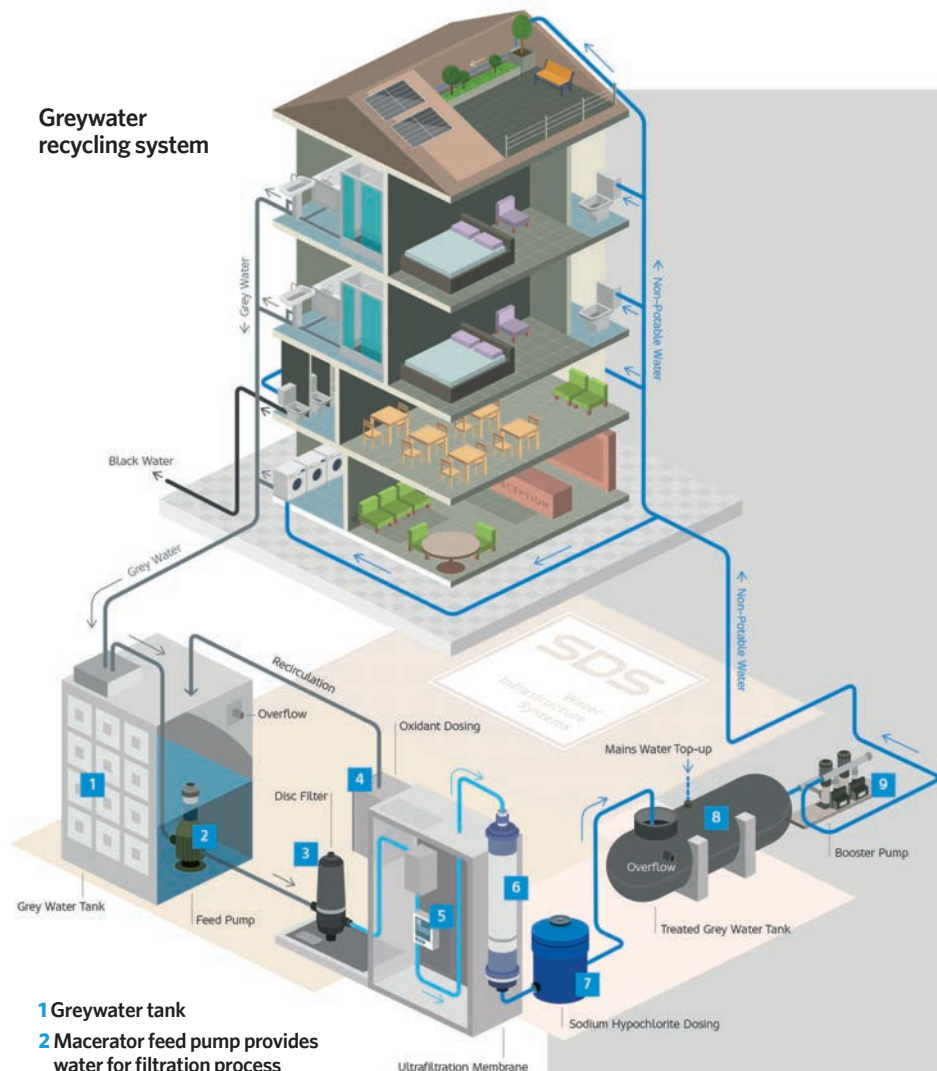
The system has a smaller footprint than a conventional membrane bioreactor (MBR) treatment system, as Dave Honey, principal public health engineer at consultant ChapmanBDSP, explains: 'By specifying the GWOD, the collection and storage tanks, which would be separate in an MBR system, could be combined to create a relatively small footprint,' he says.

It also meant the system could be positioned in a central location in the development at 80 Holland Park, allowing it to collect wastewater from as many outlets as possible. By reusing water from baths and showers for flushing toilets, the system is calculated to reduce overall mains demand by at least 15%, to an average of 90 litres per person per day. This is within the 110-litre requirement within the London Plan, and the 125 litres maximum in Building Regulations.¹ For the client, the GWOD system helped mitigate the impact on mains-water demand of the high-specification sanitaryware specified, says Honey.

ChapmanBDSP worked with SDS and the environmental engineer to specify a system that delivers 2.1m³ per day of treated greywater to flush the toilets on site. The system operates at 85.8% efficiency. 'The supplier's team produced calculations to show how much water their system would process and subsequently provide,' says Honey. 'By reviewing the full efficiency data, we were confident the system size was correct.'

The GWOD system fits in the building's plantroom much more easily than an MBR system, which employs a biological treatment

Greywater recycling system



- 1 Greywater tank
- 2 Macerator feed pump provides water for filtration process
- 3 Disk filter - self-cleaning with air-assisted backwash; finer filters remove particulates that are >20 microns in size
- 4 Oxidant dosing - oxygen added to the water before recirculation helps to prevent bacteria in the collection tank
- 5 Control panel
- 6 Ultrafiltration membrane - hollow-fibre membranes filter down to 0.08 microns
- 7 Sodium hypochlorite dosing - ensures safe chlorine levels
- 8 Treated greywater tank - includes back-up mains water feed
- 9 Booster pump

process using aerobic bacteria and digestion to treat the greywater. MBR systems use collection tanks and treated-water tanks, usually to capture up to 24 hours of greywater, with banks of reactor tanks then treating the water at a slow speed. To meet the high demand of such a building requires more reactor tanks, so the system needs to occupy a much larger footprint. An MBR system also requires venting, coarse filters and optional carbon filters to ensure smooth operation; these are not required in on-demand systems. So, it would have been difficult to design an MBR around the constraints of the building, says Honey.

'By specifying the GWOD, the plantroom could be located as centrally as possible, and the pipework could be routed without encroaching on the headroom requirements in the basement car park,' he adds.

The topography of the site meant it was difficult to collect wastewater from all of the dwellings unless the system was below the basement slab, which was not feasible. 'We had to ensure that the water collected was sufficient to provide flushing for all WCs,' Honey says.

Waste water is collected from 27 outlets around the building via pipes that are routed to a holding tank in the greywater recycling basement plantroom. This was centrally located to be within reach of as many



» outlets as possible, so it could collect from stacks of the central ‘villas’.

The collected greywater is pumped through a disk pre-filter system and dosed with a small amount of chlorine before entering ultrafilters. The ultrafiltration system is a hollow-fibre membrane with automated integral backwash that yields water to near drinking-water standards.

The treated water is then stored, ready for use, in a separate tank and pumped, as needed, to provide flushing for 88 toilets. The estimated greywater yield per day is just more than 3,000 litres when the development is fully occupied. The ultrafiltration and treatment of the water ensures it is cleaned to a very high standard, even though its primary purpose is to flush toilets, says Honey. It also ensures that no particles remain to damage valves on the system it serves.

Filtration and monitoring

Combined with cloud-based data monitoring and control, the GWOD system can feed back a wide variety of data to meet the operator’s specifications and optimise the efficiency of the system. Data collected could include flowrates, temperature, and level information, and alarms can be set up if data goes outside of predetermined limits, so anomalies

can be identified quickly for action. The system can display information via an onsite interface, and be integrated into the operator’s own BMS. Remote monitoring is also enabled for swift identification of any requirement for maintenance visits or servicing in real time.

The scalability of the GWOD system means recycled water can be provided from when the first residents move into the building. It then adapts to increasing demand as more people move in, reusing just enough water and delivering it throughout the building as needed.

The system is scalable simply by adding additional filters, which increases the skid footprint only slightly. It also operates at a high treatment flowrate for the footprint, compared with an MBR system. The only practical way to expand an MBR system to treat more greywater is to add reactor tanks, that takes up floor space and requires additional pipework and infrastructure on site.

On-demand systems also have a much quicker start-up and shutdown procedure than MBR systems. So, for example, if buildings are vacant – as happened during the Covid-19 pandemic – the system can be shut down, then restarted immediately when required.

SDS is installing its GWOD technology – sometimes with rainwater harvesting systems – at several sites in London, including residential projects, commercial offices and hotels. It has also installed systems in Europe, Mexico and the Middle East. ‘There will be an increasing need to introduce rainwater reuse and greywater recycling systems to bring down consumption of treated mains water,’ says Honey. **CJ**

SAM BURGESS is a water reuse manager at SDS

References:

1 *Approved Document G: Sanitation, hot-water safety and water efficiency.*

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The latest Code of Practice on Heat Networks includes an alternative to chemical dosing to keep systems free of corrosion. Elysator UK's **David Whitfield** explains how demineralised water and electrochemical water treatment can be used

CHEMICAL-FREE CORROSION CONTROL



REMOVING GAS BUBBLES

To remove micro gas bubbles, a passive de-aerator may be incorporated in the system. Gases in a closed-loop system dissolve in colder water, but are later released as tiny bubbles when the water heats up, or its pressure decreases. These micro-bubbles can coalesce to form a bubble large enough to rise to high points in the system. In some locations where the gas collects, it can be removed by an automatic air vent. However, the micro-bubbles can be transported to other locations where they collect, such as at the tops of radiators, where they can hinder heat transfer.

By locating a de-aerator unit immediately after the boiler, where the micro-bubbles will be present in the heated water, the unit is able to passively de-gas the water to help prevent the formation of air pockets. When the system cools, the de-gassed water will act like a sponge to soak up air in contact with the system water, to continuously and efficiently de-gas the system. On a cooling system, the unit is best installed in the return leg, where the temperature is highest, so that the de-gassing is most effective.

The units are typically installed in a side-stream/bypass configuration, so only a small proportion of the circulating flow is passed through the device on a continuous basis. But the units are sized so the total system volume should pass through the unit in a 24-hour period. Several appliances can be combined for larger systems.

One of the most significant changes in CIBSE's revised Code of Practice on Heat Networks is the inclusion of an alternative method of ensuring closed-loop heating systems are free from corrosion.

The Code of Practice CPI (2020) references a German standard that sets out how corrosion can be prevented without the use of chemical inhibitors or biocides (where the flow temperature is not intended to exceed 100°C).

VDI 2035 Part 1: *Prevention of damage in water-heating installations* is published by the Association of German Engineers, and a large number of HVAC manufacturers state that their systems have been filled to the standard in their manuals and/or warranty documents.

The standard is based on the use of demineralised water and, in part, electrochemical water treatment. These include the use of ion-exchange resins and magnesium anode technology to maintain the water in a closed-loop system in a non-corrosive state.

Corrosion occurs in heating and cooling systems when they are filled with untreated tap water. This contains minerals, salts and gases that can react with a system's metal components. The reaction can lead to the formation of sludge deposits, limescale and rust. The more water a system contains, the greater the quantity of minerals and salts, and the greater the potential for sludge.

Corrosion reactions in hydronic systems are primarily determined by the presence

of oxygen, which is why it is important that the oxygen concentration should be as low as possible. Oxygen enters the system during filling; one litre of mains supplied water contains around 8-11mg of dissolved oxygen.

Generally, in a sealed system, the dissolved oxygen from the initial fill will dissipate through limited corrosion with the metal pipework and components over a short period of time, usually without significant damage.

Systems with closed diaphragm expansion vessels are recommended because they help limit entry of air. If a system is not sealed effectively, or requires frequent top-ups – or if oxygen can diffuse through permeable seals and pipes – then corrosion will continue to be a problem for mild steel elements, such as pipework, where it will form iron oxide (Fe₂O₃), which can manifest as sludge.

To help limit corrosion, sludge and scale, the conventional approach in the UK has been to dose systems with chemicals. Some corrosion inhibitors raise the conductivity of system water and can, in the event of over-dosing or under-dosing, lead to additional corrosion.

Corrosion inhibitors can also result in the formation of biofilms, which can harbour bacterial corrosion. There are about 12 bacteria known to cause corrosion of carbon steels, stainless steels, aluminium alloys and copper alloys in waters and soils with pH4-9 and temperature 10°C-50°C. It is well documented that some chemicals provide a source of nourishment for bacteria; ironically, the solution to this is often to add yet more



The revised Code of Practice on Heat Networks has an alternative method of preventing corrosion

chemicals to the cocktail, which can make the problem worse if not handled correctly.

In addition to being an ongoing expense, chemical protection regimes require a range of health and safety procedures to be followed for the use, storage and disposal of chemicals. Also, should a leak or pipe failure occur – in a district heating system, for example – the chemically treated water can present a pollution threat or leach into the water table.

An alternative method is to fill the system with demineralised water and then maintain the system in this non-corrosive state. This is the approach promoted in VDI 2035.

Units may be installed to demineralise mains supplied water, either at initial fill or for circuit top-up while the system is operational. The approach passes the water through an excess anion (negatively charged ion) mixed-bed resin.

This technique for water treatment replaces cations (positively charged ions) in untreated water (for example, Na⁺, Ca⁺⁺, Al⁺⁺⁺) with a cation on the resin (H⁺) and the anions in untreated water (for example, Cl⁻, NO₃⁻,

SO₄⁻) with an anion (OH⁻) on the resin. This effectively removes all the salts and minerals dissolved in the water. In addition, the resin has a surplus of anions (OH⁻) to remove the free, dissolved carbon dioxide (CO₂), which in turn controls the pH of the treated water.

Various water-treatment specialists use different types of resins depending on the requirement; all demineralisation resins have hydrogen and hydroxy ions, which get exchanged with the salts and minerals present in the untreated water.

Enhanced resins can be employed which have excess anions (hydroxy ions) to demineralise the water and to effectively control the pH of the treated water.

Once a system is filled with demineralised water, its quality is maintained by circulating the system water through a unit fitted with high-purity magnesium anodes. To comply with VDI 2035, the water in a closed-loop system must be slightly alkaline with a pH value of between 8.2 and 10, and it must have very low conductivity and very low dissolved oxygen.

Critical to the electrochemistry and the function of the system is the sacrificial magnesium anode, which will corrode as it scavenges oxygen from water in the system. This galvanic process removes dissolved oxygen from the water and releases magnesium hydroxide, an inorganic compound often used in antacids as an alkaline pH buffer to help relieve indigestion.

In a closed-loop system, the magnesium hydroxide helps increase the pH of the water, turning it alkaline, and settling within the range set by VDI 2035. The result is a system with an optimum pH with minimum oxygen

concentration, where corrosion damage is unlikely. The anode will need to be replaced, on average, every three years.

Magnesium anode electrochemistry can also be a very effective way of controlling bacteria. The controlled pH, low oxygen, low conductivity and the lack of debris, chemicals and biofilms remove the environment that bacteria require to thrive.

While aluminium is recommended to operate at a more controlled pH level of 8.2 to 9, the unit can still operate effectively with these components if the pH increases. This is because dissolved oxygen and conductivity are controlled to a level where the slightly elevated pH is not as relevant and the magnesium anode is sacrificial, so will sacrifice itself to provide additional protection to the aluminium.

In addition to new systems, magnesium anode electrochemistry can be applied to existing systems, or to rectify a system where chemical water treatment has proved ineffective. When used to restore an existing system, a vortex separator enables corrosion residues carried along by the flow of water to be collected in the unit's reservoir ready for blow down, until the water runs clear.

Such systems can usefully employ a magnetic filter to remove entrained ferromagnetic material, such as iron oxides and magnetite. Conventional sludge collectors use gravity and are incapable of picking up smaller particles held in suspension when the system is operating at full flow. The magnet may be located outside the device so that it can be retracted to release the particles for removal through the sludge drain.

It's never a good idea to wait for a problem to develop before deciding how best to tackle it; taking a proactive approach is essential, especially when dealing with closed-loop heating and cooling systems. Chemical treatments often only deal with the problem of corrosion superficially, whereas using demineralised water and electrochemistry fixes the cause. **CJ**

DAVID J WHITFIELD LCIBSE is managing director at Elysator UK and contributor to CPI: Heat Networks: Code of Practice (2020) bit.ly/CJOct21DW

The code is available at cibse.org/knowledge

“Critical to the electrochemistry and function of the system is the sacrificial magnesium anode”

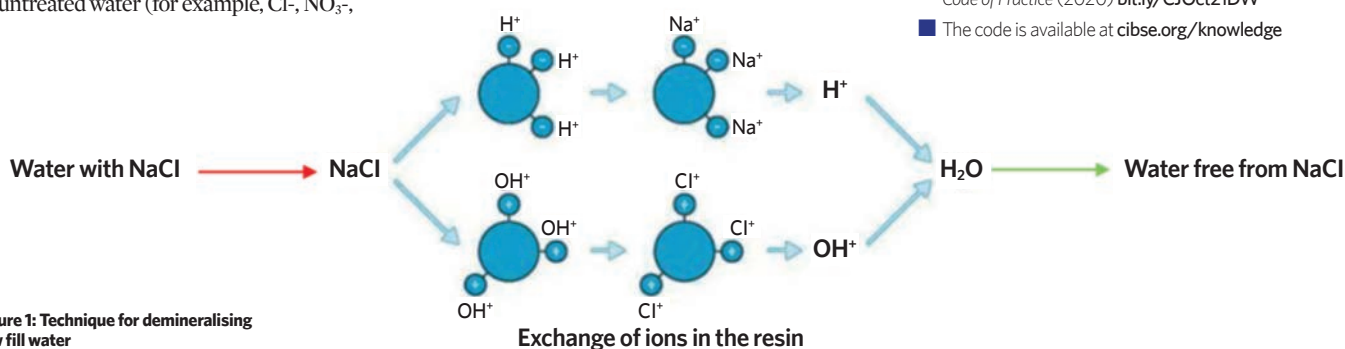


Figure 1: Technique for demineralising raw fill water

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Isolation valves for HVAC pipework systems

This module explores the use of isolation valves in domestic and commercial HVAC applications

This CPD introduces isolation valves (IVs) that are likely to be found in domestic and commercial HVAC applications. IVs are essential components of every piping system, to allow selective isolation of sections for on-off control, maintenance, removal, and commissioning. There are numerous IVs employed in a commercial system and, as illustrated in Figure 1, even a relatively small sub-system of low-temperature heating distribution pipework serving two fan coils will include in the order of 10 IVs.

The selection of appropriate IVs is based on parameters that relate to the specific application including the size and type of pipe and the operating pressure inside and across the valve; these are discussed in the boxout 'DN and PN for pipework components'.

The most common types of isolation valve employed in general HVAC applications are ball valves and butterfly valves. These are well suited to the traditional low-temperature hot water (LTHW), chilled water (CHW) and domestic hot and cold-water services found in commercial and domestic applications – and when closed, they offer a tight seal at their rated differential pressures.

Ball valves are commonly available in sizes 15mm to 50mm, and are often applied in LTHW, CHW and domestic systems. As illustrated in Figure 2, the ball has a channel through its centre, and the valve stem engages with and rotates the ball. Rotating the ball will vary the degree of opening and with a quarter turn will change the fluid flow path from, typically, full bore to fully closed. (Full bore valves will cost more than reduced bore valves but provide less turbulence and a higher valve coefficient (K_v), so lower operational cost. For an explanation of the impact of K_v see the boxout 'The cost of pumping through valves and fittings'.)

An example of a 50mm ball valve has a K_v of approximately 300-400. The ball 'floats' in the space created by the seals (typically polytetrafluoroethylene (PTFE)) that also provide the bearing for the ball. Water trapped in the channel (within the ball) when the valve is closed can present a risk of freezing and potentially

cause splitting of the body, so requires appropriate protection.

Ball valves are normally operated with a hand-operated lever, or they can be automatically controlled with an actuator. As well as circuit isolation, these are often applied as flushing valves, as in Figure 1, to isolate significant plant items when flushing and cleaning. Their robust construction ensures a long, trouble-free service life, producing minimal turbulence in the open position and tight closure in the closed position.

Unless specifically designed to do so, possibly with specifically designed, characterised inserts, a ball valve should not be used as a throttling (regulation) valve.

Butterfly valves, as in the example illustrated in Figure 3, provide a compact solution consisting of a disc that rotates on a shaft at right angles to the fluid flow. When open, the disc is edge-on to the flow and the fluid passes around it, offering limited resistance – an example 50mm butterfly valve has a K_v of approximately 100. These shut off with a quarter turn, either using a direct, simple spindle or employing a gearbox for larger valves. In the closed position, the



» disc is rotated against a seat in the body of the valve. Butterfly valves typically take up little more room than a pair of pipe flanges, and are therefore an attractive alternative to the ball valve where space is limited. With an appropriate combination of the elastomer (elastic polymer) liner and disc materials (for example aluminium-bronze, stainless steel and ductile iron), these are suitable for use on CHW, LTHW, and domestic applications. They are primarily used as on-off valves but can also be used for non-critical throttling applications. Butterfly valves are particularly useful where increased pressure and elevated temperature specifications are outside the normal operating parameters of other isolation valves.

Gate and globe valves are better suited to more arduous applications, such as the chemical and pharmaceutical industry, and are also used commonly on medium-temperature hot water (MTHW) systems or where higher-pressure rating may be required, such as PN 40. They are often employed as replacements for currently installed systems where the face-to-face dimension needs to match the valve that is being replaced, but they are less frequently used in new projects.

THE COST OF PUMPING THROUGH VALVES AND FITTINGS

Based on a simplification of the definition as given in CIBSE Guide C³ the valve coefficient (K_v) is the flow of water through a fully open valve, measured in cubic metres per hour, that will induce a pressure loss of 1bar. The flow coefficient (a constant for the open valve) is useful to evaluate the pressure drop at different flowrates as $K_v = Q/\sqrt{\Delta p}$ where Q is the volume flowrate of water ($m^3 \cdot h^{-1}$) through the valve and p = pressure drop across valve (bar), and by converting the units to those more normally used in HVAC applications, volume flowrate of water ($L \cdot s^{-1}$) and pressure drop (kPa) $K_v = 36Q/\sqrt{\Delta p}$ and this can be more usefully be reorganised as $\Delta p = (36Q/K_v)^2$

For example, considering a full-bore, butterfly valve, with a K_v of 98 (taken from manufacturer's data sheet) in a 50mm steel pipe carrying $2kg \cdot s^{-1}$ water at 30°C (such as a return LTHW return from an underfloor heating system).

For simplicity, assuming the density of water is approximately $1,000kg \cdot m^{-3}$ (actually $995kg \cdot m^{-3}$), $2kg \cdot s^{-1} \approx 2 L \cdot s^{-1}$.

So, the pressure drop through the fully open butterfly valve, $\Delta p = (36 \times 2/98)^2 = 0.540kPa$.

A similarly sized ball valve with a K_v of 338 has a pressure drop of $(36 \times 2/338)^2 = 0.045kPa$.

(These compare with a pressure loss of $0.190kPa \cdot m^{-1}$ in straight 50mm steel pipe.⁴)

Applying the relationship that power to move water (W) is volume flow ($m^3 \cdot s^{-1}$) x ΔP (Pa) indicates that by using the ball valve in place of the butterfly valve will save water power of $(2 \times 10^{-3}) \times (540 - 45) = 1W$.

For continuous operation, 1W of extra water power in the UK is likely to cost in the order of £2 each year for pump power and indirectly add 3kg to CO₂ emissions.

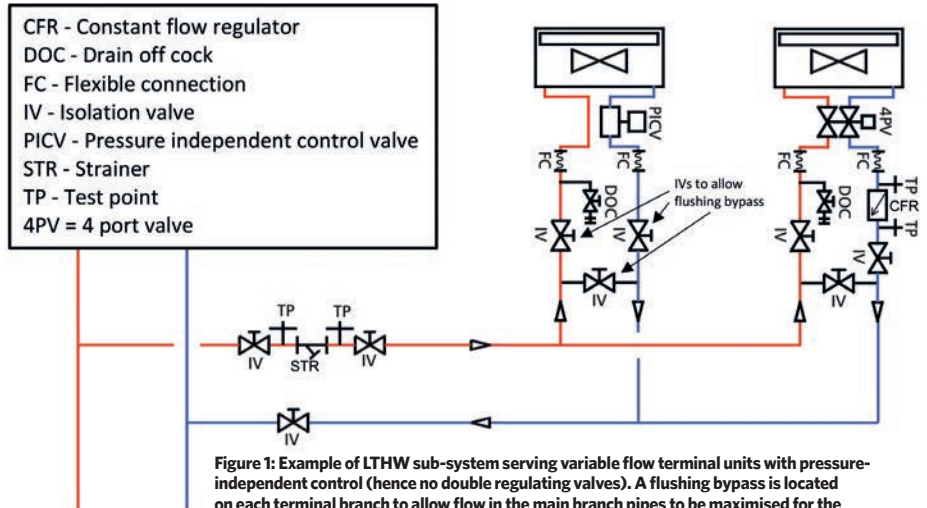


Figure 1: Example of LTHW sub-system serving variable flow terminal units with pressure-independent control (hence no double regulating valves). A flushing bypass is located on each terminal branch to allow flow in the main branch pipes to be maximised for the purpose of flushing debris out of the main pipework, in accordance with BSRIA AG 2/2020¹ (Source: Adapted from CIBSE KS9²)

Gate valves employ a gate-like disc, actuated by a stem screw, that moves up and down perpendicular to the water flow. They are available in rising stem and non-rising stem variants, as illustrated in the examples in Figure 4.

For rising stem valves, rotation of the stem drives the stem up and down as the threaded section of the stem turns in the threaded section of the body. The disc is engaged onto the end of the stem (below the threaded section) and rises/falls as the stem unscrews/screws.

The threaded stem in a non-rising stem valve screws directly into a threaded hole, into the core of the disc. As the stem is rotated clockwise, the screw draws the disc upwards, going deeper into the disc core, and so opening the valve.

The most significant difference between rising and non-rising is that the opening position of a rising stem valve can be readily observed (since the stem has risen). This will require more space than an equivalent non-rising stem valve (and the stem may be exposed to the elements).

Materials and manufacturing methods employed in modern valves mean that both types have similar operating lives and maintenance needs for HVAC applications.

Gate valves can provide dependable service, particularly where a pressure drop is important. They can allow fluid flow in either direction and the straight-through design offers little resistance to flow, and pressure drop is low. An example 50mm gate valve has a K_v of approximately 280. They should not be used for throttling, since they are not designed to provide a specific control characteristic, and subsequent damage, because of erosion, may prevent the valve subsequently providing an effective shut off.

Globe valves may be used to provide isolation, but can also provide an effective throttling device because seat and disc designs may be selected to provide flow characteristics with proportional relationships between valve lift and flowrate. Globe valve bodies are normally of a spherical shape, ensuring maximum strength against line pressures and pipeline strains. A wide choice of disc and seat materials are available to suit the application. The change in direction of the water flow combined with the restriction in the flow area mean that these valves will impose a large resistance to flow, and hence globe valves have a low K_v value – for example, around 40 for a 50mm valve – and so are not a popular choice as an isolation valve.

In most cases, IVs are likely to be hand actuated; however, most types may be readily adapted to accept motor actuation. They are typically available with stem extensions to allow, for example, access to a handwheel beyond the thickness of insulation. IVs are normally connected to the pipework by taper thread (such as in Figure 2), flange (such as in Figure 3), or by using a compression or press-fit fitting. Threaded connections may be to UK/European standard BS EN 10226-2 or US-based ANSI B1.20.1 – although these appear similar, they employ a different taper angle and are not interchangeable. All isolation valves include sealing glands and packing to prevent the leakage of water around the stem. Although modern materials, such as PTFE, can provide a long-lasting, robust seal these will still

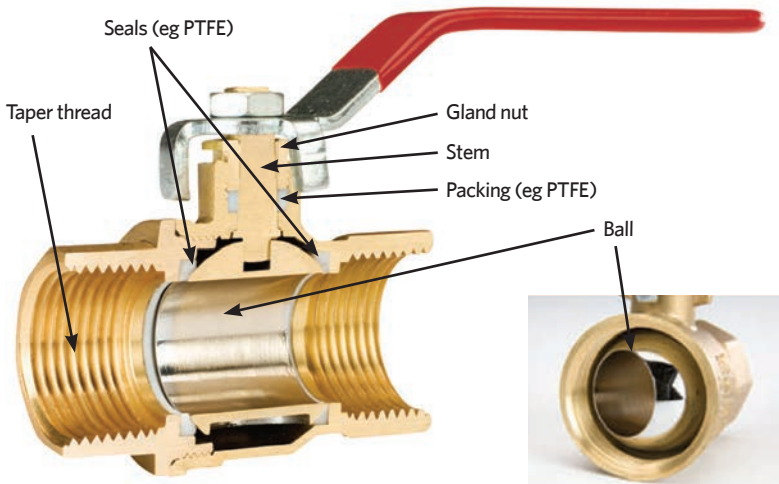


Figure 2: Example of hand-operated full-bore ball valve - open to flow in main image and part closed in inset (Source: Crane)

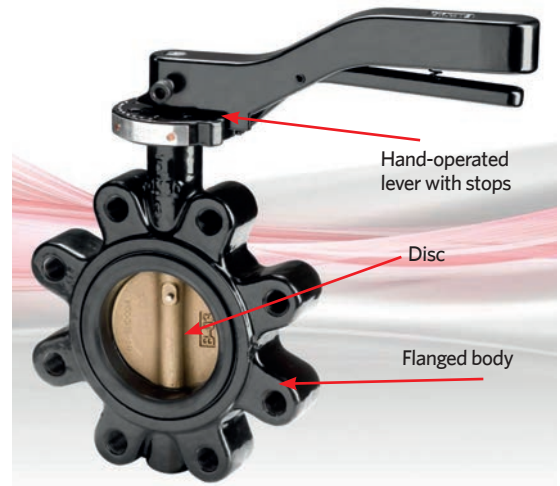


Figure 3: Hand-operated butterfly valve - the aluminium-bronze disc is rotated closed against the resilient liner (Source: Crane)

DN AND PN FOR PIPEWORK COMPONENTS

The nominal pressure (PN or 'pressure nominale') is used to specify the required pressure class for a valve. Based on a BS EN standard,⁵ PN values are quoted in Renard series values, which in HVAC applications are typically the lower values of PN10, PN16, PN25, PN40 and PN50. These indicate the maximum working pressure in bar gauge (at a specific temperature) for the valve, and should be selected for at least the highest pressure that can be developed in the piping in which they are installed. Some valves are rated in terms of ANSI/ASME class - for example, class 150 (which would equate to PN20). However, when considering flange connected valves, the flange hole configurations are not the same in the ANSI/ASME as in the BS EN standards.

The nominal diameter (DN or 'diamètre nominal') of valve connections is quoted in millimetres, with values rounded to integers that relate to the physical size of the bore or the outside diameter of the end connection. There is a preferred set of DN values⁶ that also map to the oft-quoted inch-based US nominal pipe size (NPS) with, for example, the smaller sizes DN 10, DN 15, DN 20, DN 25, DN 32 equating to NPS ½", ¾", 1", 1¼". The number following the letters DN does not represent a measurable value and should not be used for calculation purposes, except where specified in a relevant standard.⁶ So, as an example a DN 50 (2") pipe has an outside diameter of 60.33 mm (2.375") - the clear inside diameter will vary with the material and the pressure rating. Components such as valves and pipes with the same DN are dimensionally compatible with one another.

require maintenance, such as tightening of the gland nut (as shown in Figure 2).

Effective and energy-efficient selection of isolation valves in contemporary HVAC systems will require knowledge of the system operating fluid, pressure and temperature; the pipework type and dimensions; the method of jointing/connection (which will relate to the standards being applied in the particular project); and knowledge of the available space - both in the pipe and the surrounding area. This information can then be used to evaluate the most economical IV that meets the performance requirements and, importantly, has the highest value of K_v .

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■ Turn to page 76 for references.

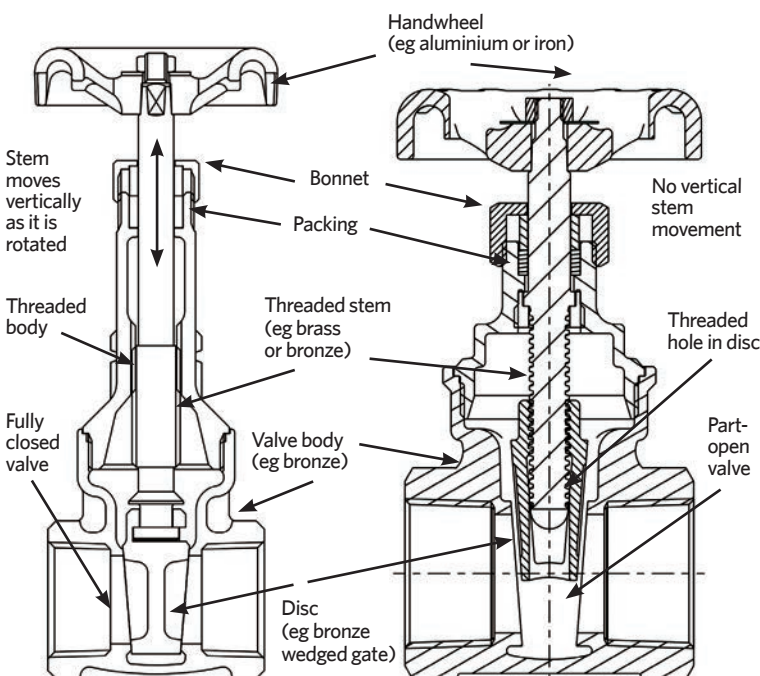


Figure 4: Section through example rising stem (left) and non-rising stem (right) gate valves (Source: Crane)

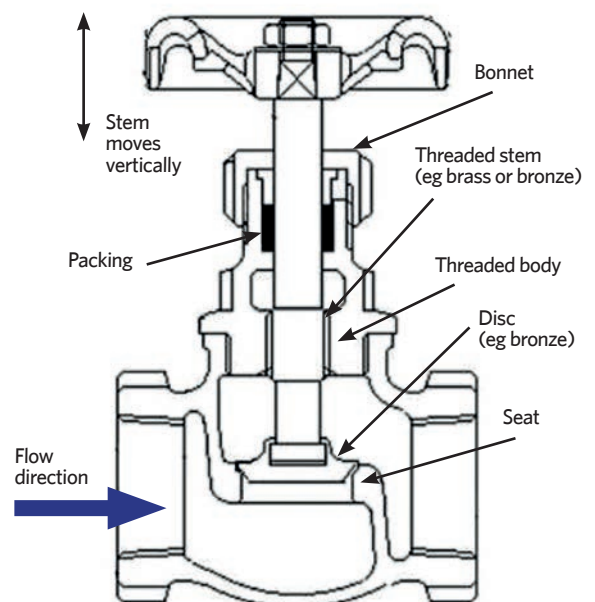


Figure 5: Section through example globe valve (Source: Crane)

Module 185

October 2021

» **1. How many double regulation valves are included in the example pipework section of Figure 1?**

- A 0
- B 1
- C 2
- D 3
- E 4

2. Which of these is least likely for a ball valve installed, for example, as part of the flushing bypass arrangement?

- A High K_v
- B Likely to be unsuitable for throttling operations
- C Manufactured with reduced bore size to lower operational cost
- D Operated by simple lever
- E Quarter turn from open to closed

3. What K_v value was quoted for a 50mm globe valve?

- A 40
- B 100
- C 280
- D 338
- E 400

4. What NPS does a DN 32 pipe size relate to?

- A 3/8"
- B 1/2"
- C 1"
- D 1 1/4"
- E 1 1/2"

5. Which of these is quoted as providing information on taper threads for pipe connections?

- A ANSI/ASHRAE/USGBC/IES Standard 189.1
- B BS EN 10226-2
- C BS EN 1092-1
- D BSRIA BG 29/2020
- E CIBSE KS9

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References:

- 1 BSRIA BG 29/2020 *Pre-commission cleaning of pipework systems*, BSRIA 2020.
- 2 CIBSE KS9 – *Commissioning variable flow pipework systems*, CIBSE 2007.
- 3 CIBSE Guide H *Building control systems*, CIBSE 2009.
- 4 CIBSE Guide C1 *Flow of fluids in pipes and ducts*, CIBSE 2007.
- 5 BS EN 1092-1:2018 *Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated: Part 1*.
- 6 BS EN ISO 6708:1996 *Pipework components Definition and selection of DN (nominal size)*.

› Products of the month

Carrier AquaEdge centrifugal chillers cool London's 22 Bishopsgate

Highly energy efficient chillers provide high-capacity cooling with a compact footprint

Carrier AquaEdge 19XRV centrifugal chillers are providing high-efficiency cooling and indoor comfort for residents of 22 Bishopsgate, London's new technologically advanced landmark building.

It has 62 storeys, with 1.275 million square feet of residential, office and indoor amenity space, designed to achieve the highest standards of sustainability and occupant comfort with a Breeam rating of Excellent. Built by principal contractor Multiplex, 22 Bishopsgate is also pursuing certification under the Well Building Standard.

The four Carrier centrifugal chillers, installed by Michael J Lonsdale, each deliver 4MW of cooling with European Efficiency Rating levels as high as 6.8.

Equipped with Greenspeed Intelligence variable-speed drives, the chillers constantly match cooling output to the building's heat load, optimising comfort, reducing energy



consumption and minimising impact on the environment. They use a new high-efficiency, dual-stage, aerodynamic impeller design, with tunnel diffusers based on aircraft engine technology. The compressor motor is cooled by refrigerant gas injection - further improving efficiency - while a patented float-valve system optimises sub-cooling and refrigerant level in the evaporator.

'Space was a key issue,' said James Snowball,

project manager with Michael J Lonsdale. 'The building's foundations and basement plantrooms were originally designed for a different project with a smaller overall floor space. This design was abandoned when the project was acquired by its current owners, in favour of a larger building with a greater focus on occupant wellbeing. As a result, the foundations were adapted, resulting in challenges to accommodate the building services plant.

'Carrier's 19XRV centrifugal chillers were proposed. They are highly energy efficient and able to provide the high-capacity cooling needed in the available plantroom space.'

Carrier also provided the equipment for cooling the building's 54 lifts and associated motor-winding rooms.

The developers were AXA IM - Real Assets and Lipton Rogers, with WSP as building services consultant.

■ **For more details of Carrier's AquaEdge 19XRV centrifugal chillers, visit: www.carrieraircon.co.uk/product/19xr-xrv-1000-5000kw**

Carrier ChillerVu Plant System Manager gives high-level automated control

Solution connects to building's BMS and provides it with real-time operating conditions

Carrier's ChillerVu Plant System Manager (PSM), employed at 22 Bishopsgate, is a BACnet control solution with an onboard library of factory-engineered control programmes designed to provide automatic control and monitoring of the most common chiller plant configurations.

It connects with the overarching building management system (BMS) to give high-level oversight of cooling for the entire building, management and control of the chilled-water system pumps, water-quality control, and demand limiting and load shedding when the building is running on generator power.

The PSM also provides the BMS with real-time operating conditions, including chilled and condenser water temperatures, chiller capacities, and their status.

The chillers at 22 Bishopsgate, located in basement plantrooms, are connected to evaporative cooling towers on level 58. A pressure break at level 25 effectively creates



a lower and upper system, requiring careful balancing at the commissioning stage to optimise flowrates and ensure excellent performance, while minimising energy use.

The control system and chillers were manufactured at Carrier's operation in Montluel,

France. Because of their high capacity and size, one of the centrifugal units had to be shipped to the US to carry out the customer witness tests at Carrier's facility in Charlotte, North Carolina.

Following successful completion of the tests, Carrier managed the supply logistics to ensure the control system and chillers were ready for installation at key points in the project build. Equipment was shipped to the UK and stored securely before delivery to site for installation and commissioning.

James Snowball, project manager with installer Michael J Lonsdale, said: 'Carrier provided outstanding support throughout all stages of the project, ensuring we had the technical information we needed, as well as timely backup and logistical support to ensure we delivered for the client.'

Founded by the inventor of modern air conditioning, Carrier is a major supplier of high-technology heating, air conditioning and refrigeration solutions.

■ **For more information, visit www.carrier.com/commercial/en/uk or follow @Carrier on Twitter.**

› Products of the month

Systemair introduces new generation of AHU air filters

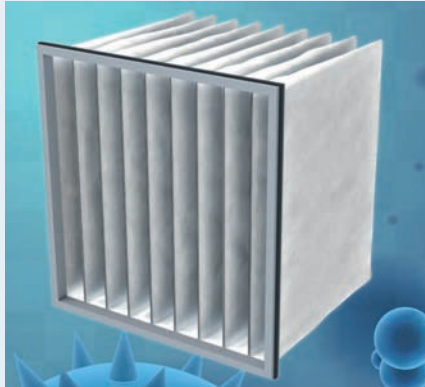
HVAC manufacturer teams up with Belgian firm to offer filters that inactivate viruses

Systemair, a global Swedish ventilation company, and Deltrian, a Belgian filter manufacturer, have joined forces to launch a new generation of virucidal filters for air handling units (AHUs).

The DELTRI+ filters are Eurovent-certified and contain advanced plasma technology capable of neutralising or destroying 99% of all viruses, including SARS-CoV-2, according to results of tests by the Luxembourg Institute of Science and Technology and an independent laboratory. The filters are already available in most of Europe and many other markets.

With Systemair DELTRI+, building owners can quickly improve existing units before considering more extensive upgrades to their ventilation systems. Compared with other methods used for virus prevention, the DELTRI+ filters offer a more straightforward solution that is easy to apply and manage.

Jurgen Alexius, owner and CCO of Deltrian,



said: 'We are proud to cooperate with one of the world's leading ventilation companies in launching DELTRI+. Systemair's technical expertise and long-term market knowledge have proven invaluable in the development of this solution.'

'We are delighted to say that DELTRI+ can capture and inactivate viruses. Its effectiveness is proven in dry and wet environments, and open and closed circuits alike. In addition, the filters reduce the risk of transmission and proliferation

of viruses and bacteria in the air. While it does not replace other preventative measures, we consider it a hands-on contribution to support a return to a more normal life.'

Neil Rapley, Systemair UK managing director, added: 'The filter is classified ISO16890 ePM1 90% F9 and holds a Eurovent-certified Performance A+ energy class rating, ensuring a low pressure drop and market-leading dust-holding capacity with the best possible energy efficiency.'

Systemair is the first HVAC manufacturer to offer air filters with DELTRI+ as replacement filters in standard and special sizes for existing AHUs. In addition, all newly built Systemair Geniox and Topvex AHUs can be shipped with DELTRI+ as an optional extra. Customers can order the product directly through Systemair local offices.

Systemair is a leading ventilation company with operations in 54 countries in Europe, North America, South America, the Middle East, Asia, Australia and Africa.

■ **For more information and FAQs, call +46 222 440 00 or visit www.systemair.com**

Rinnai commissions study to bring 'realism to an increasingly polarised debate'

Review will look at fuel efficiency in appliances using a variety of energy vectors

Rinnai has commissioned a comprehensive comparative review and report on gas and electric appliances using a variety of energy vectors in residential and commercial UK scenarios.

The commission is being carried out by one of the biggest multinational consultancies in the building and construction sector, and the final report will be headed by a team of non-political/non-partisan academics.

'We simply want to see realism brought into an increasingly polarised debate that, at times reaches levels of unbridled hysteria,' says Tony Gittings, managing director of Rinnai. 'Fact, logic and reason must be employed for the best outcome for all of us. We need decarbonisation, we need net zero, and we need it as soon as possible, but in a way that is pragmatic in terms of catering to the existing populations and markets.'

Rinnai is expected to announce its own new product development answering the net-zero



call - including low carbon technologies and hybrid solutions - before the end of the year.

'We are committing substantial sums to this report, and the contract with the authors stipulates that there is no third-party doctoring or spin. The consumer needs to be given the facts to make an informed decision.'

'We are manufacturers of proven excellence, and are using our core competencies of design engineering solutions to suit all possible future needs and fuels. We have a global reach, with 650 R&D engineers. We will evolve to ensure that our customers have the very best possible product options.'

'We believe, implicitly, that there will be a need for a variety of solutions to the energy "trilemma"; there is not one single fuel or appliance that is the answer to all the problems.'

'We also believe that some of the statements coming from quasi-official quarters is the drum banging of interested parties looking after their own primary financial and or political interests.'

■ **For more information, visit www.rinnaiuk.com**

A bright and happy dog's tale >

Dogs Trust has recently opened a new £13.5m rehoming centre, located just a couple of miles from Cardiff Bay, Wales.

The charity's 22nd rehoming centre has been devised with the welfare of 'man's best friend' at the forefront of its design, including the LED lighting solutions supplied by Luceco. The project has created a 'canine oasis', with three buildings and landscaped outside space for up to 210 dogs.

Light and airy 'sleep and run' kennels, complete with underfloor heating, have been lit with Platinum Mini downlights, while circulation areas feature linear arrays of the Contour luminaire.

The LED lighting system consists of connectable modules that can be surface mounted, suspended or recessed, as they have been at Dogs Trust to form contemporary, decorative, and highly effective illumination.

Perimeter roads and parking facilities at the new centre were lit with Viva City Pro, a modular, slimline, performance-LED street lantern, offering a choice of optics and an operational working life of 100,000 hours.

■ Call Zoe Newland-Hodges on 07890 320152 or email Zoe.nh@luceco.com



^ New installation manager at Condair

Humidity control specialist Condair has appointed James Hare (above) as its new installation manager.

Hare, who will be responsible for delivering the installation of humidifier and dehumidifier systems across the UK and Ireland, previously worked for companies including Trend, Intech, and ELPRO Global.

He said: 'I'm very happy to have joined Condair and am greatly looking forward to supporting our end-user customers, as well as our expert contractors and FM clients.'

■ Visit www.condair.co.uk

< Accurate Jung Pumpen equipment specification

For wastewater and sewage applications in commercial buildings, the Jung Pumpen Hebefix, DrainMajor and Compli lifting station are the proven pumping solutions.

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■ Call 0118 9821555, email Support@pumptechnology.co.uk or visit www.pumptechnology.co.uk or www.jung-pumps.co.uk



Breathing new life into historic building >

The Grade II*-listed India Buildings, in the heart of Liverpool, have undergone a major refurbishment, transforming the 100-year-old, 12-storey, mixed-use structure into state-of-the-art office, residential and retail accommodation.

Redeveloped for owner Legal & General by refurbishment specialist Overbury, the building has eight floors of Category A office space, delivering a Breeam and Well-compliant environment through grilles and diffusers from air-movement specialist Gilberts (Blackpool).

The 350,000ft² of commercial space is served by four-pipe heating and cooling services connected to fan coil units behind bespoke bulkheads. Consulting engineers Crookes Walker Consulting designed the ventilation strategy, which was installed by Ameen Building Services Engineering.

Lee Carey, principal mechanical engineer at Crookes Walker Consulting, said: 'We recommended Gilberts' grilles and diffusers were used because we were confident in the quality of the product, and knew we could rely on a rapid response to any technical or practical queries – crucial in expediting such a high-profile project.'

■ Call 01253 766911 or email: info@gilbertsblackpool.com



^ Panasonic launches 2021 European PRO Awards

The fourth Panasonic PRO Awards, which showcase innovation and excellence in the use of Panasonic's solutions across Europe, are now open for entries.

Projects completed between 1 November 2018 and 30 September 2021 can be entered for the accolades up until 15 November 2021. Entries can be submitted easily via the Panasonic PRO Awards website.

The winners will be announced in December, and will be featured in editorial across Europe. They will also have an opportunity to take a trip to Japan to visit a Panasonic facility.

■ Visit www.aircon.panasonic.eu/GB_en

Bosch Commercial & Industrial educates market on heat networks ▼

Heating, hot-water and steam solutions provider Bosch Commercial & Industrial has launched a new educational online resource to help support the implementation of heat networks across the country.

The Heat Networks Hub is intended to inform project developers, consultants and contractors about the cost- and climate-saving benefits of district heating technology.

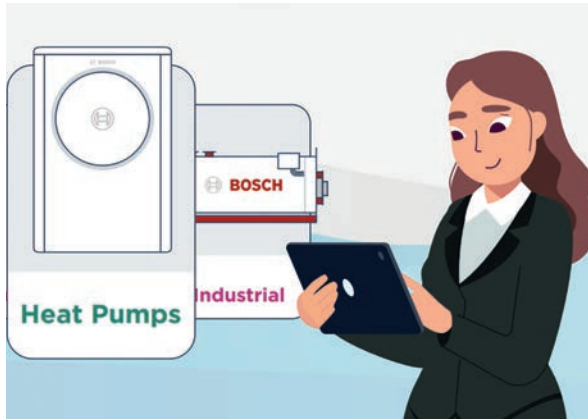
It includes a newly released animation, *Hello to heat networks*, which has details

about what heat networks offer, how they work, and their wider benefits, including versatility, affordability and future-proofing.

The hub also includes a 'Knowledge' section, with information about the latest changes and trends in this sector, and how they may affect ongoing or future projects.

Visitors can find out about Bosch Commercial & Industrial's portfolio, including its BESA-registered heat interface units, energy centre and plantroom technologies. They can also view similar heat network projects for inspiration. Training courses and CPDs are available through the hub. To find out more, visit the dedicated page on the company's website.

■ Visit www.bosch-industrial.co.uk/heat-networks



Panasonic adds adaptive ducted units to VRF range ▼

Panasonic Heating & Cooling Solutions has introduced the adaptive ducted F3 range for its VRF systems, designed for retail, hotel and office applications. The range features a new vertical mounting option and a choice of rear or bottom air inlet, plus 12 capacities – from 1.5kW-16kW – offering flexible options for installers. Just 250mm high and weighing between 26kg and 42kg, the units are suited to projects that require a more discreet fit.

■ Visit www.aircon.panasonic.eu



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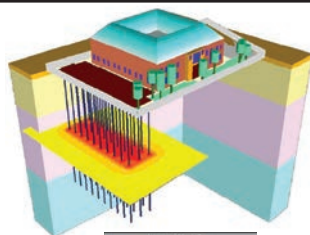
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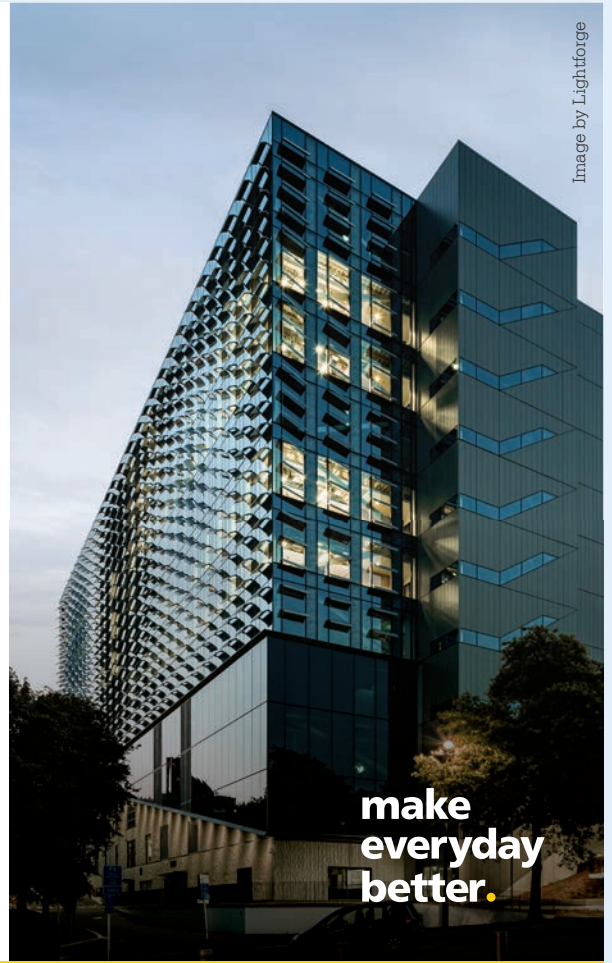


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- Write a cheque payable to the CIBSE Benevolent Fund, return to CIBSE, 222 Balham High Road, London, SW12 9BS
- Set up a regular standing order or direct debit (please email benfund@cibse.org)

- Remember the Fund in your will
- Run a local fundraising event – talk to your local Almoner: www.cibse.org/CIBSE-Benevolent-Fund/Almoners

Thank you

"I would like to take this opportunity to thank CIBSE members for their continued support, without which the work of the Benevolent Fund could not be sustained."
 – David Wood, Chair of the CIBSE Benevolent Fund Trust.

www.cibse.org/cibse-benevolent-fund

EVENTS



NATIONAL EVENTS AND CONFERENCES

Young Engineers Awards 14 October

Celebrating the best young talent in our industry, the annual Young Engineers Awards bring together the CIBSE Employer, Apprentice and Graduate of the Year awards. They reward the innovative thinking, hard work and skills of young engineers, while showcasing employers who are committed to developing young talent. Winners will be announced at the event on 14 October. To register for the virtual event, visit www.cibse.org/YEA

Ready Steady Light 2021 19 October

The Society of Light and Lighting's competition, in partnership with Rose Bruford College, returns for 2021. Teams of lighting professionals compete to create an exterior light installation with a limited range of kit.

CIBSE REGIONS AND GROUP EVENTS

For up-to-date information on regions and groups meetings, webinars and podcasts, visit www.cibse.org/events

Scotland: Deployment of solar energy in Scotland 5 October

Chris Clark, of Emtec Energy,

an energy and renewable technology provider, will talk about Scotland's net-zero ambitions, and its deployment of solar so far.

Home Counties North West: Demolition – operations, technical and design aspects 7 October

This online seminar will cover the technical, operations and costing aspects of modern demolition contractors, which are now involved in complex services decommissioning, showing how demolition is high-tech and tightly planned.

South West: Lighting for the eye and brain 21 October

With speakers Dr Shelley James, lumenologist, Age of Light Innovations, and Dr Denize Atan, senior clinical lecturer, Bristol University and honorary consultant in neuro-ophthalmology at Bristol Eye Hospital.

LIVE ONLINE TRAINING COURSES

CIBSE training courses have been reformatted to work online with a live trainer.

For the full programme, visit www.cibse.org/training

Building services overview 5 October



CIBSE JOURNAL PODCASTS

In the latest *CIBSE Journal* podcast 'How heat pumps are changing the future', sponsored by Mitsubishi Electric, consultants and industry experts discuss how heat pumps are transforming heating and cooling. All *CIBSE Journal* podcasts are available on the CIBSE Soundcloud – at soundcloud.com/build2perform – Apple Podcasts and Spotify.

Embodied carbon in MEP design: How to use CIBSE TM65 5 October

Mentoring skills workshop 5 October

Power system harmonics 11 October

Building services explained 11-13 October

Overview of IET wiring regulations (18th edition) 12 October

Electrical services overview 13 October

Introduction to heat networks code of practice 14 October

Low carbon consultant building operations 18-21 October

Electrical services explained 19-21 October

Advance simulation modelling for design for performance 19-21 October

Mechanical services overview 21 October

Residential fire sprinkler design: BS9251:2021 22 October

Fundamentals of drainage 25 October

Heat networks code of practice (CP1) 25-26 October

Mechanical services explained 25-27 October

Fire safety building regs Part B 26 October

Designing water-efficient hot and cold supplies 2 November

Design of ductwork systems 4 November

Earthing and bonding 9 November

Electrical distribution design 10 November

Low and zero carbon technologies 10 November

Above-ground building drainage 11 November

Heat networks (CP1) half-day update 15 November

Standby diesel generator 16 November

Low carbon consultant design 16-18 November

Fundamentals of drainage 17 November

ONLINE LEARNING

CIBSE has a portfolio of online learning courses, with interactive content, quizzes and additional resources. Visit www.cibse.org/training

STUDENT WEBINARS

CIBSE's student webinars offer more information about CIBSE membership. The focus is on membership benefits, including resources, societies, events and awards. Upcoming dates:

20 October
16 November
14 December

For details, and to register, visit bit.ly/CIBSEOct21briefing

CIBSE JOURNAL WEBINARS

The *Journal* hosted two webinars in September, available on demand at www.cibsejournal.com/cpd/webinars

2 September: Building up to a digital evolution, sponsored by Grundfos.

22 September: Ready or not: UPS systems monitoring and management, sponsored by Kohler Uninterruptible Power.

Membership webinars

CIBSE Membership is hosting a series of free, two-part webinars to support members with applications for the Associate and Member grades and registration with the Engineering Council at Incorporated Engineer and Chartered Engineer levels.

Upcoming webinars:

- 5 and 19 October
- 9 and 16 November
- 7 and 16 December



For further details and to register:
www.cibse.org/webinars



**YOUNG
ENGINEERS
AWARDS
2021**

REGISTER NOW



The CIBSE Young Engineers Awards recognises excellence and showcases diverse, hard-working graduate engineers and apprentices and provide an opportunity to also celebrate the very best employers in the industry who are committed to nurturing young talent.

**Thursday
14 October
2021**

ENTRIES ARE NOW CLOSED

   #WECHAMPION #CIBSEYEA

Register for the virtual awards: [CIBSE.ORG/YEA](https://www.cibse.org/yea)

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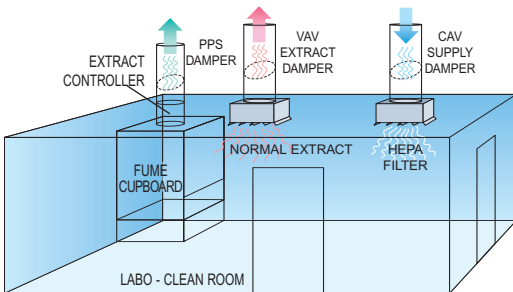


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