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## Proficiency test



Dame Judith Hackitt's interim report on the Grenfell fire has been out for two months now, but I am constantly reminded of the relevance of her findings.

Attending the launch of the CIBSE FM Group's new KS21 competency guidance (page 16), I recalled how Dame Judith had questioned the levels of competency in construction. 'The means of assessing and ensuring the competency of key people throughout the system is inadequate,' she says in her report.

This lack of competency is something that was mentioned by chair of the CIBSE Maintenance Task Group Jo Harris, at the launch of CIBSE's new guidance on competency. (It was published not in

response to Grenfell, but because it was deemed worthy of a separate publication when *CIBSE Guide M: Maintenance Engineering & Management* was published).

Harris said the 2008 recession had forced skilled building engineers out of the FM profession, and those who remained were having to dilute their skills across a wider range of engineering tasks.

KS21 explains how organisations can set up competency management systems to ensure that workers have the skills to carry out their roles. The concept can be extended to subcontractors, the idea being that anyone working on a building needs to prove they are suitably proficient to carry out a particular role. The guidance, *Competency and competency management systems in facilities management KS21*, can be downloaded for free at [www.cibse.org/knowledge](http://www.cibse.org/knowledge)

Checking for competent design, installation and operation of buildings is what Jerry Shoolbred has been doing his whole career as a clerk of works. In his role at Anglia Ruskin University, he checks every stage of the building, including any change of specification that might affect performance. He endeavours to get involved with projects at the design stage, to feed back what he's learned from previous schemes.

Shoolbred's oversight of the building life-cycle means there is a thorough handover to the maintenance team, and he ensures that the BMS is commissioned properly, so plant can be monitored remotely to spot performance issues. Soft landings are implicit in what he does and he stays on site throughout the 12-month defects period. It's a shame the role has been in decline for more than 20 years.

I hope to see many of you at this month's CIBSE Building Performance Awards. On page 26, we review one of last year's star winners, Keynsham Town Hall, which won the Project of the Year (Public Use) award. We will be bringing you the highlights from the ceremony in next month's *CIBSE Journal* and will focus on the best of the winners throughout the year.

**ALEX SMITH, EDITOR** [asmith@cibsejournal.com](mailto:asmith@cibsejournal.com)

### Editorial

**Editor:** Alex Smith

**Tel:** 01223 378034

**Email:** [asmith@cibsejournal.com](mailto:asmith@cibsejournal.com)

**Deputy editor:** Liza Young

**Tel:** 01223 378048

**Email:** [lyoung@cibsejournal.com](mailto:lyoung@cibsejournal.com)

**Technical editor:** Tim Dwyer

**Designer:** James Baldwin

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### Advertisement sales

**Consultant:** Jim Folley

**Tel:** 020 7324 2786

[jim.folley@redactive.co.uk](mailto:jim.folley@redactive.co.uk)

**Senior sales executive:** Paul Wade

**Tel:** 020 7880 6212

[paul.wade@redactive.co.uk](mailto:paul.wade@redactive.co.uk)

**Sales manager:** James Rundle-Brown

**Tel:** 020 7880 7556

[james.rundle-brown@redactive.co.uk](mailto:james.rundle-brown@redactive.co.uk)

**Advertising production:** Jane Easterman

**Tel:** 020 7880 6248

### Editorial advisory panel

**George Adams**, engineering director, Spie Matthew Hall

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## CONTRIBUTORS



**Hywel Davies**  
CIBSE's technical director looks at the response to the Clean Growth Strategy and a call for urgent action



**Donald Daw**  
The rising price of refrigerants and how it is encouraging more efficient building design



**Liza Young**  
Our deputy editor finds out how a clerk of works keeps major university projects on track



**Tim Dwyer**  
February's CPD looks at how ventilation can be applied to mitigate overheating in homes



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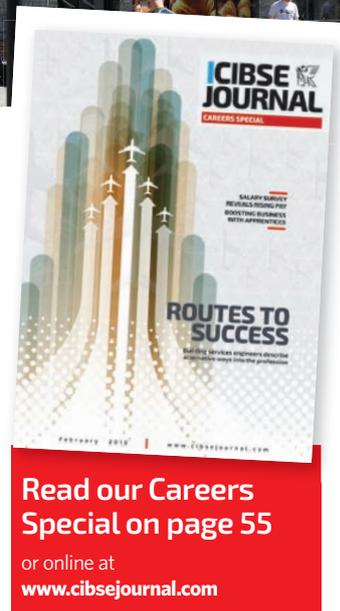
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## FOR CIBSE

Journal production manager: Nicola Hurley  
Tel: 020 8772 3697, [nhurley@cibse.org](mailto:nhurley@cibse.org)

CIBSE, 222 Balham High Road,  
London SW12 9BS

Tel: +44(0)20 8675 5211

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## V&amp;A'S £80M DUNDEE MUSEUM TO OPEN IN SEPTEMBER



The first fit-out for the V&A Museum of Design Dundee, which juts out over the River Tay, has been completed by contractor BAM.

Arup designed the building services for the £80.11m museum, which is due to open in September.

The 8,000m<sup>2</sup> building, with 1,650m<sup>2</sup> of gallery space, uses geothermal energy – with 30 200m-deep bore holes – to heat and cool the building, supplemented by air source heat pumps on the roof. These supply direct renewable energy for the museum, with 800,000 kWh per year of heating and 500,000 kWh per year of cooling.

Designed by Japanese architect Kengo Kuma & Associates, the three-storey building, inspired by cliffs, has curving concrete walls, which hold 2,500 pre-cast rough stone panels.

## Carillion collapse prompts call for payments reform

**Up to 30,000 businesses owed money by insolvent company**

As many as 30,000 smaller firms may be owed money by Carillion, which collapsed in January carrying more than £1.5bn of debt. Much of this is in the form of withheld payments for completed work, so is classified as 'unsecured'. As a result, it is unlikely to be recovered in full, according to insolvency experts. This has prompted calls from industry bodies for the immediate reform of payment practices throughout construction.

Around £75m of Carillion's debt is owed to 80 engineering services firms, according to data gathered by the Building Engineering Services Association (BESA) and the electrotechnical and engineering services trade body ECA. They also found that the total value of ongoing contracts with Carillion is £47.2m, and much of this work is now on hold.

BESA and ECA's snap poll of members also revealed that micro businesses (those with fewer than 10 employees) are owed, on average, £98,000 by Carillion, but one is owed more than £250,000. Small firms (10-49

employees) are owed £141,000 on average, but one is owed £800,000; medium-sized businesses (50-249 employees) are owed, on average, £236,000 – but one is owed almost £1.4m; and the very largest businesses (250+ employees) working for Carillion are owed, on average, £15.6m.

According to its latest accounts, Carillion was holding more than £800m in retentions payments owed to subcontractors, but the firm's liquidators, PwC, said it will not honour payments for work completed before 15 January.

Secretary of State for Business, Energy and Industrial Strategy Greg Clark met a delegation from the building engineering sector a few days after Carillion went under. They urged him to: support the introduction of payment security measures for supply chains; ensure subcontractors are paid directly, via project bank accounts; and ban extended payment terms, such as the 126 days imposed on subcontractors by Carillion.

They urged him to get behind the draft bill introduced by Peter Aldous a week before Carillion collapsed, that seeks to ensure retention money is held in a deposit-protection scheme. (See page 8).

## Hackitt calls for radical action on fire safety

Dame Judith Hackitt has called for radical action to create a new robust and regulatory framework to ensure the safety of residents in complex and high-rise towers.

More than 50 industry leaders attended a summit last month to discuss how industry, regulators and government could work together to respond to the six major findings in Dame Judith's interim report on fire safety following the Grenfell fire (news, *CIBSE Journal*, January 2018).

She announced that six working groups would be established. A design, construction and refurbishment workshop will look at embedding building safety during design and construction, while an occupation and maintenance group will identify what owners, landlords and regulators will need to do to ensure safety is prioritised through a building's life-cycle.

One group will see how product testing and the marketing regime could be improved, while another will look at establishing competency requirements for individuals involved in constructing and managing complex buildings.

A workshop on residents will look at how occupants can be given a statutory route for raising concerns over fire safety.

Finally, one group will look at regulation and guidance, and consider whether central government ownership of technical guidance is the most appropriate model.

At the summit, Dame Judith said: 'We can now say with confidence that there is widespread agreement that the current system of regulation for high-rise and complex buildings is broken, and that we need a radical overhaul and a change in culture.'

## Quest to find missing 20,000 engineers

Organisers of the government-backed Year of Engineering campaign, which is due to run throughout 2018, say it aims to tackle the annual shortfall of 20,000 engineering graduates that harms economic growth.

The government and its 1,000 industry partners will deliver 'a million inspiring experiences of engineering for young people, parents and teachers' – including a Siemens See Women roadshow, aimed at encouraging women to pursue STEM careers.

The Science and London Transport museums will be capturing children's imaginations with interactive exhibitions, while schools will get the chance to go behind the scenes at Airbus to meet Mars Rover engineers. Visit [www.yearofengineering.gov.uk](http://www.yearofengineering.gov.uk)

## Scottish schools 'must set temperature limit'

Schoolchildren in Scotland are being subjected to overheated classrooms that impair their ability to learn, the Educational Institute of Scotland (EIS) has said.

It wants a maximum acceptable temperature in classrooms to be set by the Scottish government, to safeguard the health and wellbeing of pupils and staff. Schools are subject to workplace regulations that specify a minimum acceptable temperature of 16°C, but there is no maximum. Pupils are often sent home when temperatures are too low, but there is no guidance on what to do in the event of overheating.

Currently, a 'reasonable' top temperature should be maintained in learning environments, but EIS has said this is 'too vague'.

# Second reading for retentions bill after clearing first hurdle



The bill calls for a deposit-protection scheme

**In the past three years, more than £700m was lost by construction SMEs**

An attempt to introduce legislation to reform the controversial practice of retention payments in the construction industry has overcome its first hurdle in parliament.

After the first reading of the proposed bill – introduced under the 'Ten Minute Rule' by Peter Aldous on 9 January – it was announced

that the second reading will be in the House of Commons on 27 April.

The bill has attracted strong cross-party support, including from 11 'sponsoring' MPs. It seeks to amend the 1996 Construction Act so that retention money is held in a deposit-protection scheme, to secure it against the threat of supply chain insolvency.

The average UK contractor has £27,500 withheld every year in retentions, which limits their ability to invest in apprentices, upskill employees, and improve productivity. In the past three years, more than £700m was lost by small and medium-sized construction businesses as a result of companies holding onto their cash and then going bust. This amounts to £900,000 every working day.

During the reading of his bill, Aldous said: 'More than £10.5bn of SME's potential working capital is locked up in retentions every year and £7.8bn was unpaid in the past three years.'

## Parking fire worse for lack of sprinklers



A huge car park fire in Liverpool, which destroyed more than 1,600 vehicles, would have been far less severe if the building had been fitted with sprinklers, according to the local chief fire officer.

Despite arriving within eight minutes of the alarm being raised, firefighters were unable to contain the blaze that engulfed the seven-storey car park. 'I believe a sprinkler system would have suppressed the fire. It would definitely have given us a much better opportunity to put out the fire before it spread to the extent it did,' said Dan Stephens of Merseyside Fire and Rescue Service.

Trade body the Business Sprinkler Alliance (BSA) added that sprinklers could have reduced the size of the insurance claim resulting from the fire. Although the structure is not in danger of collapse, BSA chairman Iain Cox said 'it is unlikely it can be saved, and will require demolition and rebuild', the cost and environmental impact of which will be significant.

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# 'Hard' Brexit could jeopardise 43,000 jobs, economists warn

## Building materials would also become more expensive without a trade deal

Economists commissioned by the Mayor of London have warned that 43,000 construction jobs will be lost if the UK leaves the European Union without a favourable trade deal next year.

Cambridge Econometrics suggested the industry's skills shortage would become more acute in the event of a 'hard' Brexit that did not allow for freedom of movement. It said that almost 13% of UK-based construction workers were born abroad, while in London and the South East that proportion was as high as 50%. If the industry does not have access to this pool of workers, wages would be expected to rise, along with labour-supply contracts, pushing up the overall cost of projects. This could have a detrimental effect on the government's ability to deliver its ambitious new housing targets.

As much as 64% of building materials are imported from the EU and these would become more expensive if there is no trade

deal in place post-Brexit, the analysts said. The industry might also lose access to the European Investment Bank and the European Investment Fund, which together put €7.8bn (£6.8bn) into major infrastructure projects, and lent €666m (£582m) to SMEs in 2015.

The economists, also calculated a potential drop of €852m (£744m) in foreign investment in the sector by 2030.



## 'Greenest year ever' for electricity

Data from the National Grid shows that 2017 was the greenest year on record for UK electricity generation.

In June, wind, nuclear and solar generated more UK power than gas and coal combined for the first time. In April, meanwhile, the country had its first 24-hour period without coal power generation since the Industrial Revolution.

Overall, renewable sources generated more power than coal for 90% of the year, and wind farms produced more electricity than coal on more than 75% of days during 2017. The cost of offshore wind power also fell below the price of nuclear for the first time.

## BEIS offers £8.8m for smart ideas

The Department for Business, Energy and Industrial Strategy (BEIS) has launched an £8.8m fund to invest in new ideas for products and services that use smart-meter data to reduce energy demand in small, non-domestic buildings.

This is part of its wider strategy for rolling out smart meters to all homes and businesses by 2020, and is funded through the Small Business Research Initiative.

BEIS is to run a competition, inviting proposals for developing software tools from smart-meter data, which are then used to encourage firms to save energy. Possible strategies include: using information, such as estimates of financial costs or savings; advice on actions that can reduce energy demand and costs, such as heating controls and lighting; and tailored messages to encourage the uptake of advice and sustained behaviour.

## Clean Growth Strategy 'lacks detail'

The parliamentary group that advises the government on climate-change policies has criticised the newly launched Clean Growth Strategy for a lack of detail and clear actions.

The Committee on Climate Change (CCC) said there were 'significant gaps' between the government's proposals and the targets it needs to achieve to meet its future carbon budgets.

'The Clean Growth Strategy is ambitious in its aims to build a thriving low carbon Britain, but ambitions alone are not enough,' said chair Lord Deben. 'As it stands, the strategy does not deliver enough action to meet the UK's emissions targets in the 2020s and 2030s.'

He urged the government to 'firm up' its policies 'as a matter of urgency', particularly around the energy efficiency of commercial buildings by 2030 and in the residential sector by 2035. The CCC also called for more steps to improve the proportion of heat delivered by heat networks.

■ For more, read Hywel Davies' column on page 20.

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## NEW US EMBASSY CLAIMS 'ENVIRONMENTAL LEADERSHIP'

The US Embassy in London has opened south of the River Thames in Nine Elms.

The building was designed by architect Kieran Timberlake, with Arup responsible for sustainability, MEP, fire protection and civil engineering.

The building's façade was designed to maximise the use of natural daylight; it uses multiple-layer, laminated glazing – with an outer scrim of pressurised ethylene tetrafluoroethylene (ETFE) pillows on the east, west and south façades – to screen excessive solar gain and glare.

An underfloor air distribution system provides cooling, while passive chilled beams and perimeter, thin-film radiators deliver additional peak cooling/heating without increasing overall air-change rates.

Cooling is generated by absorption chillers that use waste heat from the biomass-fuelled CHP, linked to a district heating. A deep-well aquifer supplies potable water and an onsite water treatment plant collects grey and wastewater.



## Parliament refurbishment delay is 'national disgrace', says Black Rod

### Leakey accuses MPs of failing to address risk that Houses could 'burn down'

A crucial debate about plans to refurbish the Houses of Parliament was cancelled in January, because MPs refused to hold the session on a Thursday.

The need for a comprehensive revamp of the historic building's structure and services has been flagged as urgent, but the debate had yet to be rescheduled as *CIBSE Journal* went to press.

The government is due to publish a motion on the repairs – including the appointment of a management board and delivery authority to oversee and deliver the programme of works – but this has been continually delayed for four years.

Andrea Leadsom, Leader of the House of Commons, said the government was trying to find a suitable alternative date, but had to take account of representations 'for the debate not to be scheduled on a Thursday'.

David Leakey, who is due to step down from his post as Black Rod – responsible for the maintenance and security of parliament – told BBC's Radio 4 that the hold-up was a 'national disgrace'. 'Yet again, the future of Britain's most historic building is being put at risk of falling into decay – or even being destroyed by fire – because MPs can't make a decision,' he said.

'MPs are not above the law. If this were any other building, it would have been closed because of its asbestos situation.'

'In light of Grenfell, the Houses should be setting an example, not taking the risk that the place could easily burn down.'



## Smart measures cut energy bills by 18%

Retrofitting smart technology to commercial buildings can cut energy bills by 18% in offices, 14% in shops and 8% in hospitals, according to a report by the American Council for an Energy Efficient Economy (ACEEE).

The report analysed the use of: occupancy sensors; smart thermostats; demand-controlled ventilation; electronic films for windows; automatic shading; tenant comfort feedback systems; smart plugs; and cloud-based energy management information systems. It noted that many US building owners were aware of the opportunities in smart tech, but were unsure how to make it work or what the savings might be. They were also concerned about cyber security risks.

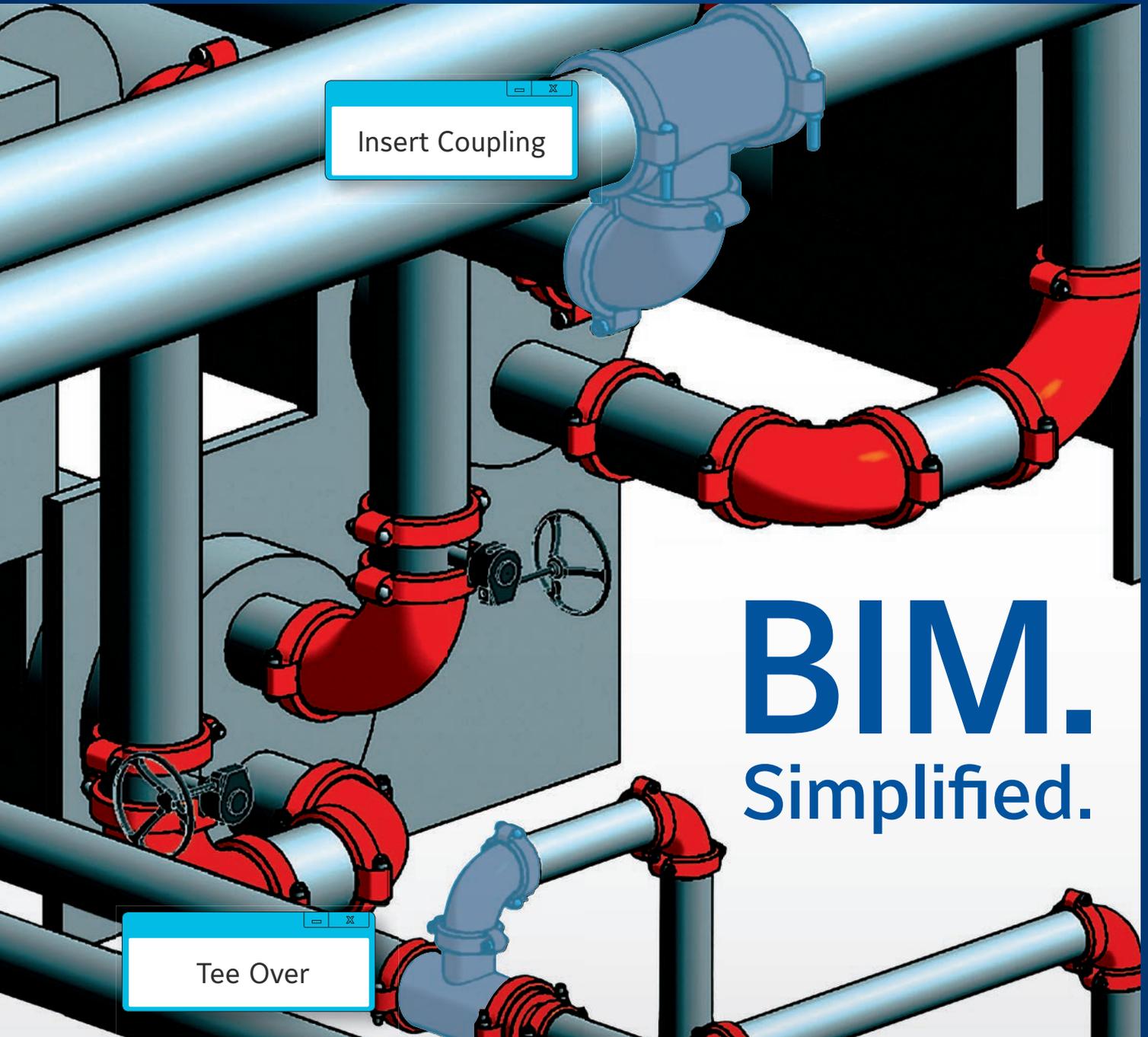
New 'Class A' office buildings tend to include interoperable systems, but most of the US's one million offices would have to be retrofitted. The report highlighted 'low-hanging fruit', such as upgrading lighting and fitting wireless thermostats that turn off the heating if nobody is present, which can save up to 10% of total heating, ventilation and air-conditioning costs.

It recommended fitting sub-meters, so tenants can be charged for the electricity they actually use, and rooftop HVAC packages with smart control, wireless CO<sub>2</sub> sensors and variable speed drives.



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Please note this does not relate to your copies of *CIBSE Journal*, which are a benefit of your CIBSE membership.

### Book now for the 2018 Technical Symposium

'Stretching the envelope' is the theme of the 2018 Technical Symposium, which will be held at London South Bank University on 12-13 April, and is now open for booking.

The event will focus on the techniques and technologies used for healthy and productive environments. It will explore new ideas and examine applications that stretch beyond 'business as usual' to meet the challenges of climate, resource, environment and security.

With more than 70 peer-reviewed papers being presented over the two days, the symposium offers a unique opportunity to participate in discussions on the established and proven, as well as the developmental and cutting-edge. To book your place and for more information, visit [www.cibse.org/symposium](http://www.cibse.org/symposium)

# More detail needed on capital's green ambitions

## Wider benefits of green infrastructure in relation to wellbeing are not accounted for

By Michelle Wang

A key focus of the draft London Plan is to create policies that realise the mayor's manifesto commitment to make more than half of London green by 2050.

This is evidenced by the large chapter dedicated to green infrastructure – which encompasses green-belt strategies, community gardening and urban greening – and another chapter on sustainable infrastructure.

These two sections largely refer to the London Environment Strategy 2017.

### Urban greening

A new green infrastructure policy is the introduction of the urban greening factor (UGF). This tool has been used elsewhere in Europe – where it is known as the green space factor – and will be applied to all major applications to ensure a desirable amount of 'greening' on a plot of a given size. More information on the UGF can be found in chapter 8.5 of the draft

London Plan and in the *Urban Greening Factor for London* report, produced by the Greater London Authority and the Ecology Consultancy.

'Greening' techniques include green walls, open water, and rain gardens. The factor is calculated by a formula, and an example is included in the draft plan.

Residential development will be held to a higher standard – with a target score of 0.4 – because of the greater demand for green space, while commercial developments will have to achieve a score of 0.3.

Different surface-cover types are given scores from 0 to 1 – for example, green walls will score 0.6 and water features 0.2. These are then calculated against the surface area to generate a composite score.

The UGF seems to be an attempt to systematise the way value is given to greenery, but it requires local authorities to assess their individual needs and create a version for their borough. More detail is needed to gauge how much change it will bring about, and its potential effectiveness, as there could be a lack of uniformity across boroughs.

### Encouraging, but lacks clarity

The draft London Plan offers more stringent guidelines on some issues, but lacks clarity on others. In addition, the separation of 'green infrastructure' and 'sustainable infrastructure' hints at a somewhat blinkered approach to environmental issues that require integrated and strategic planning.

It is not apparent how the wider benefits of green infrastructure are being accounted for in relation to the city's wellbeing and – more importantly – overall sustainability. For example, the sustainability of a piece of green infrastructure must be considered against all other environmental costs and benefits, including water management, energy use, and air quality. It is encouraging to see a stronger stance for a more sustainable future, but policies need to be integrative and ambitious to deliver a holistic approach.

■ CIBSE will submit a response to the London Plan consultation, but would like to hear from you so it can best represent your views. Please let us know if you would like to contribute to the response, or you can send your comments to head of sustainability development Julie Godefroy at [JGodefroy@CIBSE.org](mailto:JGodefroy@CIBSE.org) by Friday 9 February.

■ Michelle Wang is studying for an MA in environment, politics and globalisation at King's College London, and is currently interning at CIBSE





Clockwise from top left: Tate Modern, V&A Museum entrance, Berkeley Hotel entrance

## Quench your thirst for knowledge with regular CPD

The CIBSE code of conduct requires all members to actively maintain – and, where possible, encourage others to maintain – their professional competence through systematic improvement and broadening of their knowledge and skills. This must be done in accordance with institution guidelines on continuing professional development (CPD).

All members registered with the Engineering Council are also expected to maintain and enhance their competence.

The institution takes these requirements very seriously and conducts an annual audit of 500 members to ensure CPD records are being maintained.

In 2017, 14 members did not respond to repeated requests to supply evidence of their CPD and, as a consequence, were not invited to renew their membership in 2018.

Maintaining a record of your CPD is very straightforward and can be done online through your 'My CIBSE' account. For more information, visit [cibse.org/cpd](http://cibse.org/cpd)

## CIBSE membership briefing webinars

The CIBSE membership team is hosting a number of webinars to help support members as they move up the membership grades.

The webinars will focus on the qualification requirements and application process for the Associate and Member grades, and registration with the Engineering Council at the Incorporated Engineer and Chartered Engineer levels. The webinars come as a two-part series, and forthcoming dates for the first part are:

6 February, 6 March and 4 April. Find out more and book at [www.cibse.org/webinars](http://www.cibse.org/webinars)

Workshops are also available, to help you get started on your report and application. Visit [www.cibse.org/workshops](http://www.cibse.org/workshops) to book.



# London façades out in front at annual awards

## The Axel Towers project in Copenhagen also received a special commendation

Three London projects have taken titles in the 2017 Façade of the Year competition, run by the Society of Façade Engineering (SFE). The annual awards, which recognise outstanding and innovative architectural façades, attracted the largest number of international entries to date, and were presented at the Glass Supper event in December.

The UK division of Danish-based consultancy Ramboll won the Façade Of The Year New Build for the Blavatnik Building, Switchhouse Extension of the Tate Modern.

Octatube won the refurbishment category for the new entrance at the Victoria & Albert Museum, in Exhibition Road, London.

The Outstanding Façade Innovation Award was given jointly to Catalonia-based

façade specialist Bellapart and Arup Façade Engineering for their work on the new entrance to the Berkeley Hotel in Knightsbridge. This is the second year in which the Bellapart/Arup partnership has produced a winning entry.

In addition, FKN Group received a special commendation for its work on the Axel Towers landmark project in Copenhagen.

Head of the SFE judging panel Saverio Pasetto said: 'The purpose of the competition is to draw attention to the importance of façades in modern architecture. Our winners have succeeded in achieving that, with façades that are diverse but equally remarkable.'

The awards' headline sponsor was Reynaers, and other sponsors were: E H Smith Specialist Façades; Holloseal Glass; Interface Façade Engineering; Century Façades; Allies and Morrison; Wintech; Wedge Group; and Skanska.

# Final call for entries to CIBSE/UKCIP green design challenge

The deadline for entries to the third annual Green Infrastructure Design Challenge, run by CIBSE and UKCIP, is fast approaching.

Supported by Ecobuild, the challenge aims to highlight the role of building-level green infrastructure – such as green roofs, living walls, indoor farms and gardens – in creating sustainable indoor and outdoor environments.

This year's competition wants entrants to consider what constitutes a healthy, productive and sustainable urban environment, from a building-performance perspective and as an improvement of surrounding public spaces.

The challenge is open to students, qualified practitioners and researchers, either as individuals or in teams.

Shortlisted entrants will be expected to outline their design in a three-minute presentation at Ecobuild, with the winner announced at the event on 6 March.

The deadline for entries is 19 February. For more information about the challenge and to enter, visit [www.cibse.org/GIChallenge](http://www.cibse.org/GIChallenge)

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# The competency conundrum

To ensure engineers' skills match their roles, organisations must continually assess the competencies of their workforce. Alex Smith reports from the launch of CIBSE guide KS21, which explains how competency management can be embedded in maintenance engineering

The latest guide in CIBSE's Knowledge Series, on competency, has just been published. Produced by the CIBSE Maintenance Task Group, in association with the CIBSE Facilities Management Group, the guidance offers an understanding of competence and competency, focusing on the management of building engineering systems in operational buildings. It explains what individuals and organisations need to do to become fully competent.

KS21 *Competency and competency management systems in facilities management*, explains the steps organisations should consider taking to improve and manage the skills of workers. Its goal is to ensure that those involved in the operation, maintenance and management of buildings have the right level of competency to carry out essential engineering, maintenance and repair tasks.

At the guide's launch in central London, co-author Jo Harris said it had been written because there was no single place to go to for information on competency in facilities management (FM). She added that this was essential because legislation was pushing organisations into ensuring individuals were competent (this is covered in the guidance).

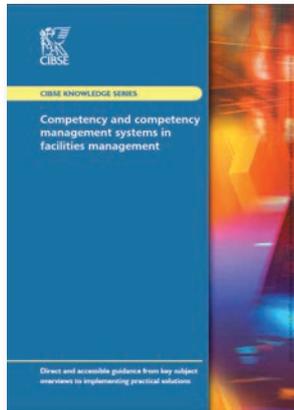
The challenge is, Harris continued, that there are fewer skilled engineers as a result of apprenticeships being abandoned after the 2008 recession. 'We have multiskilled people and we have diluted their knowledge,' she said. 'They can't be Jacks of all trades and still be competent in multiple areas.'

The guide has a particular focus on the management of competency in multidisciplinary teams. 'A lot of managers are coming into FM from diverse backgrounds,' said Harris. 'They need to understand what they have to comply with and how they ensure teams are competent.'

Part of the effective management of competency is the keeping of records, says co-author Steve Gathergood, to ensure individuals' skills are tracked over time. 'The onus of proof of competence will always fall on the employer or organisation,' he said.

Gathergood explained the competence continuum (see Figure 1), which shows how the level of proficiency relates to the level of supervision needed. 'Competency can be influenced by a number of external factors, such as a change in behaviour, technology or environment,' says Gathergood. 'It has to be continually assessed.'

By doing regular reviews, you are in a better position to put in corrective actions, he added. For example, as



The new CIBSE guide KS21 is available free to members

an apprentice gains experience, is trained and acquires confidence, he or she moves to the right of the continuum and the line manager can step back. If the technology changes, a person may no longer be competent for the role, and will need to be retrained.

Co-author Steve Hunter explained the principles of the Competency Management System (CMS), which are described in the guidance. The CMS cycle describes the five phases from establishing requirements and designing the CMS to implementation, maintenance, and review.

'The aim is to ensure people are clear about what they have to perform, what's expected of them, and how they can receive appropriate training to remain competent,' said Hunter.

'It is a strategic differentiator when you go out in the industry. It shows you have a good management structure backed up with evidence.'

Summing up at the launch, Harris said it was in everyone's interest to monitor engineers' competencies and to train them if they need more skills to carry out their roles. 'Too many engineers bounce between contracts because they don't feel valued. Task-based performance reviews can help overcome this.'

*Competency and competency management systems in facilities management* KS21 is available free to CIBSE members at [www.cibse.org/knowledge](http://www.cibse.org/knowledge)

**JO HARRIS** is chair of the CIBSE Maintenance Task Group, and controls and project engineer at Eli Lilly UK

**STEVE GATHERGOOD** is head of infrastructure services at G4S Facilities Management

**STEVE HUNTER** is global technical support manager at JLL

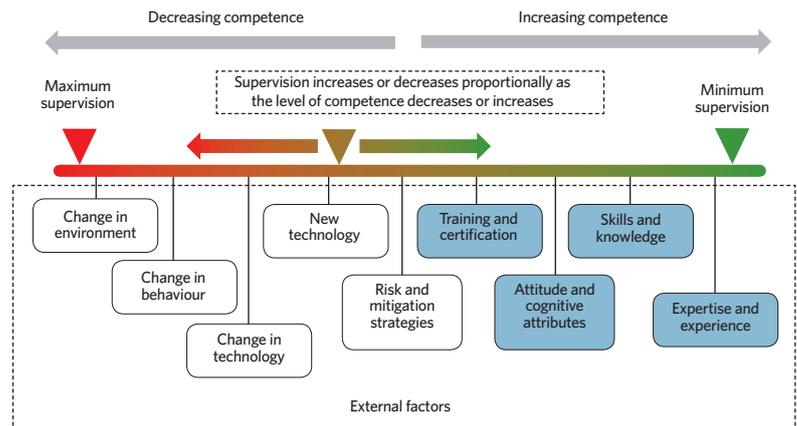


Figure 1: The competence continuum shows how supervision decreases as proficiency increases

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More than 70 people died in the Grenfell Tower fire



## Responses to Dame Judith Hackitt's report on fire safety and Carillion's collapse

### Where liability lies

As suggested by the article 'Grenfell response demands more robust building control' (*CIBSE Journal*, November 2017), responsibilities and liabilities of building control are unclear – and UK law does not help matters. It is my understanding that, had Grenfell not resulted in any fatalities or injury, the result would have been pure economic loss, and building control would be without liability. Because Grenfell resulted in fatalities and injury, however, the relevant building control agency is at risk if it is found to be at fault. Presently, building control is a life-safety agency, not a building-safety one.

*Murphy v Brentwood District Council* [1991] 1 AC 398 places liability for compliance with Building Regulations firmly at the doorstep of the employer, who passes this to the contractor et al. The relevant UK government portal makes it clear that 'meeting the requirements of the Building Regulations is the responsibility of the person carrying out the building work'. So if the building/structure should later fail for any reason, the relevant building-control agency will not be liable, providing there is no fatality or injury. The portal also states that 'notwithstanding the possibility of enforcement action, you should bear in mind that, if the local authority or approved inspector considers that building work carried out does not comply with the Building Regulations, and it is not rectified, no completion/final certificate will be issued, and this is likely to come to light through a local land-search enquiry when you wish to sell your property'.

If building control is to continue to be a mandatory requirement – for which the owner must pay, enter into a binding contract and then face prosecution if they fail

to comply – is it not reasonable that the relevant agency should be held accountable in the event of a failure, regardless of injury or fatality?

*Andrew Baker, MCIBSE*

### From concept to realisation

Dame Judith has done a good job, given the instant response required by politicians and activists, but there are two comments that CIBSE could take forward.

First, on competency and related education, we should return to the practice of insisting would-be design and management professionals spend adequate time on site – perhaps six to 12 months – so they have 'hands-on and dirty' experience of what can be realistically achieved given the site conditions. This must include architects, who are as much building engineers as their plumbing colleagues. The aim must be to drum into designers the differences between concept and realisation of concept, where the bottom-up feasibilities may lead to changes in the top-down ideas.

Second, the idea that there should be some person on whom 'responsibility and accountability' rests is flawed, given the only practical way of arranging a design to be constructed. The flaws are the reason we need what Hackitt so rightly asks for – absolutely clear Building Regulations. These affect the designer and constructor alike. Perhaps there is a case for pulling in, and automatically assigning, responsibilities through truly adequate specification, whether the design is by nominal designers or a contractor's subs and sub-contractors. The NBS would need a good once-over to make sure this aim can be achieved.

Building Regulations would be altered if drafting committees were considered semi-permanent groups, which accept that only operational experience can show the revisions to be carried out, and that such revisions should be set out as quickly as possible. The industry can no longer accept the HSE's standard comment, when asked about ambiguities (including during Dame Judith's years in charge), that 'only the [law] courts can decide the meaning'. It might be five years or more after a design is initiated before a court comes to a conclusion, so it would be more useful if the drafters could at least state an intention to an early-in-design question, even if a legally watertight statement has to wait.

*John Moss, MCIBSE*

### CIBSE LinkedIn group discusses Carillion's downfall

#### John Bradley

The domino effect to the supply chain, and potential of numerous small companies going to the wall, could be minimised if these large contractors paid net 30 days payments and [stopped] using the supply chain as their financing arm.

#### Robert Smelt

The problem is salespeople who are over-rewarded for securing projects/orders based on value. If they were rewarded for securing projects that both work



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and are financially viable we wouldn't be in this mess. Our culture of 'it's got to be the cheapest price or else it won't get an order' must change.

**Andrew M Ebonwonyi**

[We need] to get professional bodies in the UK to regulate the activities of companies. Regulatory action will help signal the possible collapse of companies before it happens.

**Tracy-Jane Duncan-Moir**

We need to get some morals and professionalism back into Britain. It's become too much of a dog-eat-dog world, resulting in the cheapening of the industry. Instead of employing companies on quality, all too often it just comes down to price. This then allows the big cats to dominate the industry and how – or should I say if – they pay. Let's get the quality back into the marketplace.

**David Fisk**

Carillion is not the only company that annually reports poor profits 'caused by one-off events' but reassures the stock market that it has a full order book in the pipeline. Only those orders are likely to be just as unprofitable because they've been won at any cost. I don't see why the public sector is being let off the hook. Their procurement practices set the scene.

**David Westwood**

Everyone is blaming Carillion and its directors and – to a large extent – they are responsible, but public sector procurement, and its payment regime, has a lot to answer for.

**Christian Beier**

This may be a lesson to learn that procurement of lowest-priced contracts is not necessarily the best value – or safest in the long term. The procurement decision-maker(s) need to be 100% sure that all measured specification elemental costs are priced as 'included'. Any grey areas need to have a separate cost basket. A lot of procurement decisions are based on comfort politics – he did this job for me before, so I am happy using him again – rather than on sound logical cost offer versus specified project delivery commitment.

**Phil Dodd**

Many years ago, I worked with a main contractor that would take work at cost, or less, and then beat up the subcontractors by not paying extras, renegotiating quotes and not paying on time, to make a profit. It all looks fine to the client because they never know what is happening behind the scenes. And most don't want to; they just want a building that gets built to a budget.

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

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# Mind the emissions gap

The government urgently needs to publish carbon-reduction policies if it is to meet emissions targets. Hywel Davies reports

The government's Clean Growth Strategy sets out the next steps to reduce UK greenhouse gas emissions and tackle climate change, and is required by the Climate Change Act.

The Act commits the UK to an 80% reduction in carbon emissions by 2050, compared to 1990 levels. This is to be achieved through five-yearly carbon budgets, set by the government using the advice of the independent Committee for Climate Change.

The fifth carbon budget was set in June 2016, and the Clean Growth Strategy – originally due out later that year, but finally published in October 2017 – is the plan for delivering it.

In January, the committee published its analysis of the strategy, which it said was ambitious, but did not go far enough. Further urgent work is needed to develop the plans and proposals, and supplement them with additional measures, if the UK is to meet its legally binding carbon targets in the 2020s and 2030s.

We have made good progress in reducing greenhouse gas emissions since the Act was passed in 2008. Emissions fell by 42% between 1990 and 2016 – faster than the average rate of reduction in the G7 group of industrial nations.

The latest strategy commits to further action on delivering the fourth (2023-27) and fifth (2028-32) carbon budgets, as we work towards the 80% target for 2050. It reaffirms the UK's desire to remain at the forefront of tackling climate change globally. The committee states that this makes it all the more important that the UK carbon budgets are met through domestic action to reduce emissions, which is the basis on which the targets were set.

Significant gaps remain between the current reductions that will be delivered through existing and new policies – including those set out in the strategy – and the targets set by the fourth and fifth carbon budgets, according to the committee. It estimates the shortfall at around 10-65 metric tons of carbon dioxide equivalent (MtCO<sub>2</sub>e) – a significant margin.

The committee recommends that the government urgently firms up policies and proposals in the Clean Growth Strategy. It wants to see more detail about: the phase-out of sales of petrol and diesel cars and vans by 2040; the increase in home energy efficiency by 2035; the improvement in energy efficiency standards of new buildings; the phase-out of installations of the most polluting fossil-fuel heating in homes and businesses off



**“The committee will monitor progress through annual reports to parliament”**

the gas grid; the generation of 85% of the UK's electricity from low-carbon sources by 2032; the improvement of the energy efficiency of UK businesses and industry by 2030; and the deployment of carbon capture and storage technology at scale in the UK in the 2030s. All these will have to be delivered in full and on time to realise the required emissions savings.

The committee also wants the government to develop and implement new policies to close the ‘emissions gap’ to the fourth and fifth carbon budgets. It identifies a particular risk of not meeting the fourth carbon budget, which starts in 2023, and has called for urgent domestic measures. These could include greater near-term improvements in the energy efficiency of buildings, especially in able-to-pay households. The committee also wants steps taken to ensure a greater proportion of heating from heat networks is from low carbon sources.

Given the large gap that already exists to meet the fourth carbon budget, and the 15-month delay in publishing the Clean Growth Strategy, the next steps need to happen pressingly.

Urgency is stressed throughout the report; defining the additional carbon-reduction policies must be pursued with vigour, urgency and sustained commitment. The report identifies significant delivery risks with new and existing policies to reduce emissions – such as timely completion of Hinkley Point C nuclear power station – and calls for them to be actively managed.

It notes the importance of this in the context of the Paris Agreement, which the UK and 172 other countries have ratified, and which will require increased efforts to reduce future emissions.

While the government has proposed milestones to measure progress, the committee recommends additional benchmarks to ensure the required emissions reductions are delivered in time. It will monitor progress through annual reports to parliament.

The UK may be leaving the EU, but the committee's report effectively confirms the view that there is no scope for scrapping energy efficiency policies and legislation that originated in Brussels. This will merely increase the size of the gap to be filled. The challenge for services engineers is to identify how we might deliver the energy efficient homes and buildings we need.

#### References:

<sup>1</sup> An independent assessment of the UK's Clean Growth Strategy: From ambition to action [bit.ly/CJFeb18HD](https://bit.ly/CJFeb18HD)

# A capital idea for all?

The draft London Plan aims to make the city zero carbon by 2050 – but, asks Hilson Moran’s Marie-Louise Schembri, what are the benefits for end users?

It’s probably best we start with one of the most ambitious areas of the draft London Plan – making the city zero carbon by 2050. As part of this long-term, phased strategy, the mayor is proposing that all major new developments are net zero carbon from 2019. While this is not new for residential developments – with the current target for non-residential buildings at 35% – the plan introduces minimum targets for onsite energy efficiency savings and overall onsite low carbon initiatives for these schemes. Whatever savings cannot be met on site can be offset through a payment at planning – as is currently the case – or developers may be given an option to offset carbon offsite, as long as evidence of delivery is provided.

So how does this affect development proposals? The minimum saving required from energy efficiency measures is going to make architecture, construction detailing and building services work even harder, especially in residential. The 35% onsite minimum target will continue to force major developments to go down the district energy route, but the draft London Plan proposes a heating hierarchy, similar to the current cooling hierarchy. Will this confuse things further and affect planning costs?

Refreshingly, the draft London Plan moves away from the current emphasis on combined heat and power (CHP) and prioritises use of secondary heat and fuel cells. In fact, a focus on air quality – and a requirement for the heat source to demonstrate lower NO<sub>x</sub> emissions than an ultra-low NO<sub>x</sub> boiler – may mean the death of CHP in future projects. Selective non-catalytic reduction (SNCR) systems for controlling NO<sub>x</sub> cannot currently achieve these levels, despite their large attenuation capability.

The offset payment to the new zero carbon target for non-residential is bound to increase planning costs for developers, but it should also result in more passive/hybrid energy efficiency strategies in offices, and encourage more innovation in the capital. These include mixed-mode ventilation and intelligent environmental controls, which are also being driven by an increased awareness of the financial benefits of workplace wellbeing.

Shell and core developments, such as retail, will struggle to achieve the onsite target unless letting agents and the retail sector catch on to the new London agenda. The same goes for developments next to high-level noise sources and where there is already poor air quality.

The third tier, Be Green – known as the energy hierarchy – unsurprisingly lists energy storage alongside



**“Landlords should empower tenants to take control of their energy bills”**

renewable technology. We envisage heat recovery, energy storage and heat pumps to feature strongly in near-future energy solutions in the city, and this is something Hilson Moran is advocating firmly.

There is great potential for carbon offset payments to unlock energy savings from existing stock in London. However, the draft London Environment Strategy focuses on funding to overcome fuel poverty, mainly for residential. The draft London Plan’s heat hierarchy is interesting, but is rarely going to be applied to existing housing stock. While capturing and storing waste heat, renewables, and smart energy management will all be necessary if we are to meet national carbon targets, they are not going to solve fuel poverty unless thermal fabric is improved.

To explore options for those affected the most – developers and end users – we recently completed a study on how storage batteries, alongside other infrastructure, can benefit all parties to a greater extent. While we’re in agreement that capturing and storing energy is essential, we believe

there is a great opportunity for developers to get a return on investment from energy infrastructure and smart energy metering. Landlords should empower tenants to take control of their energy bills, and residential developers and landlords should encourage consumers to do the same.

Developers are spending more capital expenditure on energy infrastructure than ever before and this trend is expected to continue. While energy-storage systems will probably reduce the relative need for utility reinforcements, it has started to make financial sense for developers to own energy infrastructure, rather than sell it off to an energy services company (Esco). This enables a return on investment from an additional asset on site.

Allowing flexibility and cost savings for the occupant can also be addressed through smart energy management technology, although this has to be enabled by the developer and factored into the Esco’s financial model. A move in this direction is already under way, with electricity network operators giving considerable time and resources to changing their system architecture in preparation for an increase in renewable energy generation and storage by consumers – so why not encourage it further?

As an industry, we are responsible for the longevity and sustainability of new buildings and refurbishments. The mayor’s draft plan addresses sustainability, but we need to make this feasible, and find innovative ways to tackle our energy issues.

## MARIE-LOUISE SCHEMBRI

is an associate sustainability consultant, and head of the Masterplan Energy & Environment Group at Hilson Moran

# PICTURE PERFECT

Louvre Abu Dhabi will exhibit priceless artwork, so an environmental strategy that protects them from sand and extreme heat was essential. **Andy Pearson** explains how BuroHappold Engineering did it

Designed by French architect Ateliers Jean Nouvel, Louvre Abu Dhabi comprises 55 buildings laid out in an organised jumble beneath a giant, silvery, lattice dome. This 180m-diameter cupola is made up of eight layers of steel and aluminium, which form 7,850 star-shaped perforations of various sizes. Through these gaps, sunlight dapples the azure waters of the Arabian Gulf surrounding the complex, and mottles the white walls of the museum's 23 permanent galleries.

The Emirati art gallery opened in November and is home to some of the world's most valuable artworks. It is supported by Agence France-Muséums (AFM), the organisation of which the Paris Louvre is a part. AFM indicated precise environmental criteria for the gallery spaces to the Department of Culture and Tourism – Abu Dhabi (DCT) and Louvre Abu Dhabi.

'Gallery conditions were recommended at 21°C, plus or minus 1°C, and 50% relative humidity (RH), plus or minus 5%,' says Mark Owen, associate director at BuroHappold Engineering, the project's MEP engineers. This is no easy task in an Emirate where summer temperatures can reach 45°C and RH levels in winter can exceed 60%.

In addition to the galleries, the strict environmental criteria had to be maintained in four vestibule areas, a highly secure conservation building, and some back-of-house spaces; the requirement even applied to some of the lifts and lift shafts.

For the non-gallery areas of the 58,000m<sup>2</sup> scheme – including the cluster of entrance buildings, the ubiquitous shop, a gourmet restaurant, cafeteria, children's gallery and an auditorium – AFM set a slightly more relaxed design criteria of 21°C +/- 5°C and 50% RH +/- 5%. 'There are two levels of environmental control: close control and not quite so close control,' laughs Owen.

AFM also set criteria for airflow in the galleries, which it wanted to flow over the artworks in a laminar fashion, to avoid hot or cold spots. 'We couldn't use displacement ventilation, for example, because that would have created temperature stratification, and AFM would not permit a temperature differential to occur across any of the artworks,' explains Owen.

## Ventilation

The engineers were helped in developing the ventilation solution by the galleries' low fabric-infiltration rate. 'To protect the art from pollution, sand, temperature and humidity fluctuations – and to save energy – the client specified an infiltration rate of just 2m<sup>3</sup>/m<sup>2</sup>.h at 50Pa,' says Owen. With the exception of the aluminium and steel dome, the complex and its two basement levels are constructed from cast in-situ concrete, up to one metre thick in places. Envelope construction is the same for all the galleries, although the size, shape and volume of each one is different.



### PROJECT TEAM

**Client:** The Tourist Development and Investment Company of Abu Dhabi (TDIC)  
**Architect:** Ateliers Jean Nouvel (AJN)  
**Executive architect:** Pascall+Watson  
**MEP Engineer:** BuroHappold Engineering  
**Contractor:** Joint venture between Arabtec Construction, San Jose SA and Oger Abu Dhabi



Azure waters of the Arabian Gulf surround the new museum, designed by Ateliers Jean Nouvel

Laminar air flow in the galleries is achieved using ceiling-mounted Kiefer linear diffusers. Extract is, predominantly, through low-level grilles mounted in the walls; there is also a nominal amount of extract at ceiling level. 'The galleries are a minimum of five metres high; the art zone extends up to four metres from the ground, which means the air diffusers basically have one metre in which to achieve a laminar flow before the art zone, without hot or cold spots,' says Owen.

Although computational fluid dynamics (CFD) modelling had shown the design solution to be effective, it was decided to construct a full-size gallery mock-up at BRE's Watford campus, to test the performance of the diffuser and that of the CFD model. 'The mock-up verified the modelling, which allowed us to roll out the design across all of the galleries, confident that the scheme would perform as designed,' Owen says.

Each gallery has dedicated run and standby air handling units (AHUs) concealed in the 10m deep, double-height basement, an arrangement that improves security and allows the plant to be maintained without engineers having to access the galleries. The standby unit is in place because the client did not want the failure of a single item of plant to jeopardise the environment protecting the artworks. In total, the museum has 108 AHUs and 43 close-control units serving the smaller rooms and galleries.

Having dedicated AHUs serving each gallery ensures environmental conditions can be maintained independently of the other galleries. Each gallery's AHU draws fresh air from what Owen calls 'the fresh air ring' and discharges extracted air to the 'exhaust air ring'. These 'rings' are, >>

» effectively, giant loops of ductwork distributed around the basement in a services tunnel, to serve the building and all gallery AHUs and close-control units.

The fresh air duct ring is supplied with conditioned outside air by four large primary AHUs (three duty, one standby) mounted in the central basement fresh air plantroom. They have stainless steel sand-trap louvers on the intakes, to prevent the desert sand from entering the units and to help resist corrosion in the marine environment. The secondary AHUs of the gallery systems connect to these primary ring mains. 'This arrangement allows much smaller AHUs to be used to supply the galleries – it's like a giant fan-coil system, to put it crudely,' explains Owen.

The volume of air supplied by the primary units varies, based on the fresh air loads required to keep CO<sub>2</sub> levels below 600ppm and on the need to maintain the galleries at a positive pressure, to prevent the ingress of unconditioned outside air. Extracted air is returned to the primary AHUs, where useful energy is reclaimed using enthalpy wheels.

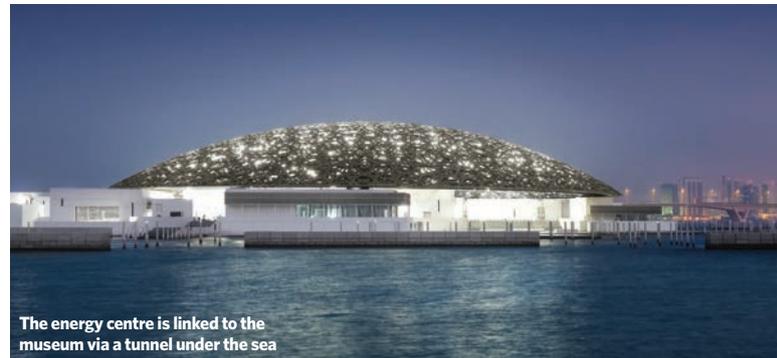
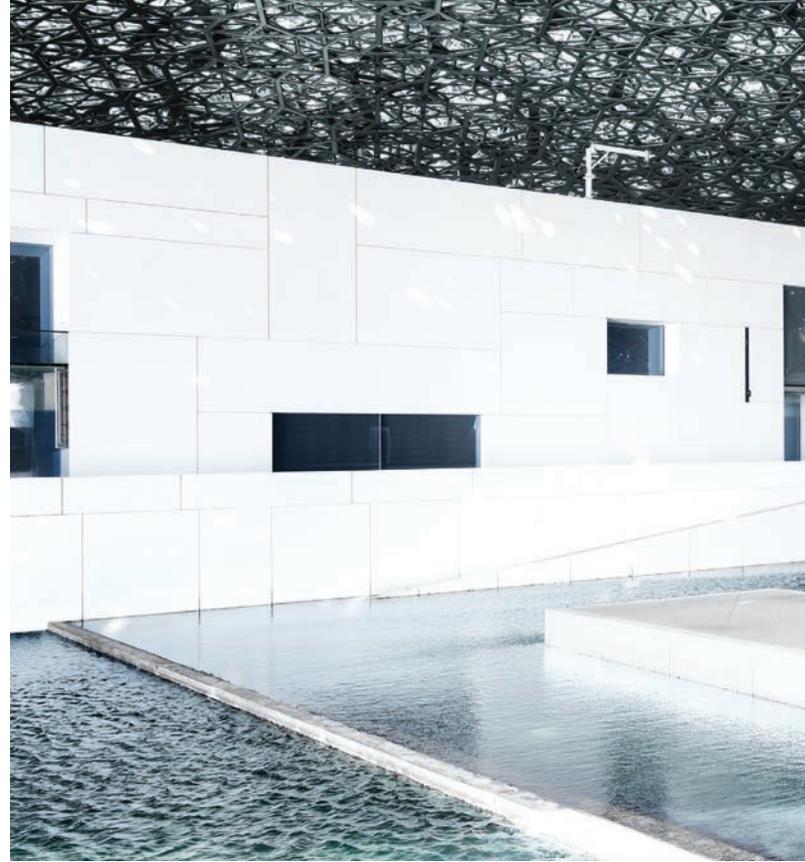
'The primary air handling units deal with all the fresh air load, while the gallery units do the air conditioning,' says Owen. 'We used this system because it gives us a level of operational safety: if ever there was an issue with the primary air plant, it could be shut down while the gallery systems continue to operate in isolation.'

The entire air system was tested over a 28-day period before handover, as part of the validation process for acceptance by AFM.

### Fire protection

Operation of the supply air system is relatively straightforward under normal conditions. Under fire conditions, however, things get more complicated. 'The cause and effect analysis we undertook was the most complicated I have ever worked on,' says Owen.

One of the challenges was that the museum could not have inert gas or water fire-suppression systems in the galleries and spaces where artworks are housed. Local building codes, however, required sprinklers to be installed. As a result, BuroHappold's fire engineers had to develop a bespoke smoke-ventilation solution that would be acceptable under the Emirate's fire rules,



The energy centre is linked to the museum via a tunnel under the sea

but would eliminate the need for sprinklers. According to Owen, the starting point in developing the solution was to make every gallery a fire compartment. 'Should a fire break out anywhere in the museum, all the gallery ventilation systems will switch to full recirculation to protect the artworks,' he says. At the same time, the main fresh air plant would be switched off and isolated.

If the fire was in one of the galleries, the gallery would be isolated from the remaining spaces by fire shutters, and the ventilation system for that

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



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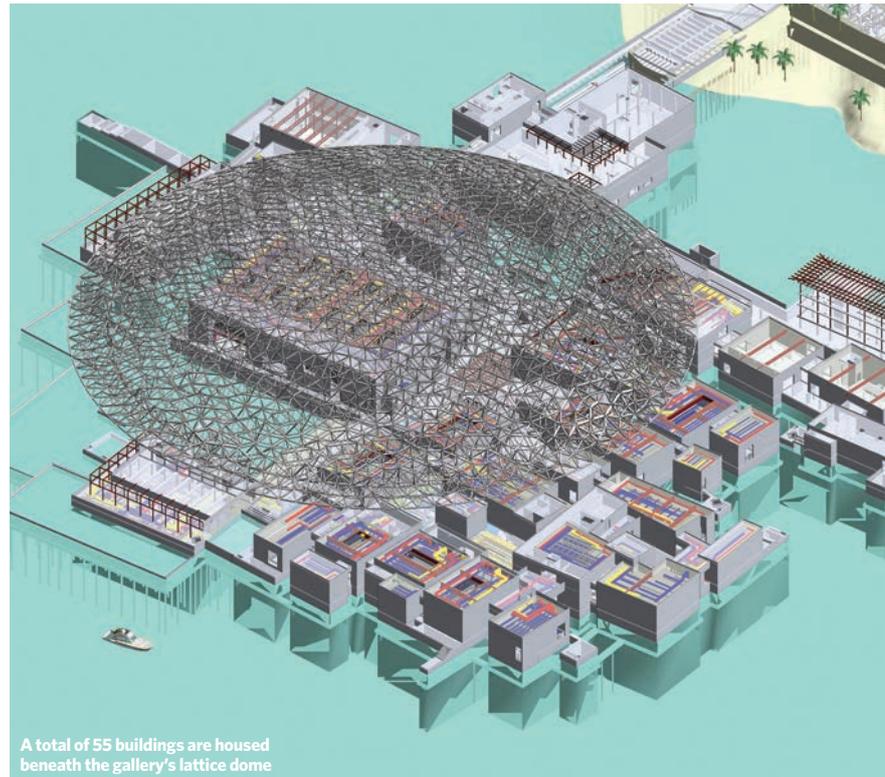
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Fax +44 (0) 1268 287099  
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Light permeates the domed roof of Louvre Abu Dhabi



A total of 55 buildings are housed beneath the gallery's lattice dome

## “CFD modelling had shown the design solution to be effective, but it was decided to construct a full-size gallery mock-up at BRE”

room would switch to smoke-extract mode. In normal operation, air in the gallery moves in a downward direction, from the ceiling supply to the low-level extracts. In smoke extract mode, however, the air moves in an upward direction, as smoke-extract grilles in the ceiling pull smoke from the gallery via a dedicated smoke-ventilation system.

Make-up air is supplied to the gallery by separate supply fans located in the basement, which provide an increased air volume via the fresh air rings. The make-up air bypasses the gallery AHUs and is routed to low-level and in the gallery and supplied through what were the low-level air extracts. ‘There are some very clever damper arrangements in the gallery plant rooms,’ says Owen.

Predictably, the architect did not want his creation marred by visible building services plant or flues. Because of the museum’s in-the-round, island location, the main energy centre is remote from it, buried out of sight on the adjacent Saadiyat Island. The plant is linked to the museum via a service tunnel under the sea – the same tunnel used to deliver art to the museum in air conditioned vehicles.

### Desert heat

There are no chillers in the energy centre because it is fed by 10.5MW of chilled water from the island’s district cooling plant. There are, though, heat pumps and – surprisingly in the desert – boilers too. ‘The heat pumps and boilers are there to reheat the fresh air supply, because it has to be cooled to such an extent to dehumidify it, that it has to be reheated to maintain the supply condition,’ says Owen.

In fact, the boilers are only installed to provide backup to the heat pumps. These have been designed to take heat energy from the chilled water return, which is used to reheat the fresh air. Once the useful heat

has been extracted, the cooled water from heat pumps rejoins the chilled water return – an arrangement that helps reduce the cooling load on the district cooling system.

The plantroom is also home to 10 transformers – six large 22kV transformers at 1,500KVA, and four smaller 11kV transformers, also at 1,500KVA. There are five emergency generators. Four 2.25MVA units, developing 11,000V, are located in the energy centre, and supply the four 11kV transformers. The 630kVA generator is on top of the conservation building as a precaution, should everything in the energy centre fail – what Owen calls ‘the doomsday scenario’. At such times, the museum can move the art into the conservation building, which has its own dedicated, stand-alone chillers and air handling systems. It is entirely self-supporting, to protect the valuable artworks using building services – which, themselves, are a work of art. □

### DAYLIGHT AND THE ARTWORKS

The majority of the galleries are sheltered from the searing Arabian sun by Louvre Abu Dhabi’s lattice dome. Most incorporate a rooflight and some even have windows overlooking the sea. One of the key challenges for BuroHappold was to ensure sunlight would never fall on the artworks.

The engineers modelled the path of the sun over 365 days. Then, using BIM technology, they developed the dome’s complex, multilayered design to allow the sun’s rays to permeate the galleries without touching the art.

To achieve precise levels of light in rooms that have a combination of natural and artificial light, BuroHappold’s New York office produced a series of reports that predicted the sun’s path and anticipated daylight levels for each gallery. The reports even took into account the sensitivity of specific artworks to light.

All windows and rooflights incorporate three blinds – two to diffuse daylight and a third to act as a blackout blind. These operate automatically, based on a schedule produced by the modelling, combined with the output of light sensors giving real-time data. If light levels get too high, the blackout blinds prevent the possibility of damage to the artworks.

# CIVIC PRIDE

Ahead of the Building Performance Awards, **Andy Pearson** looks at how soft landings and a passive-first approach made Keynsham Civic Centre Project of the Year (Public use) in 2017

**B**ath and North East Somerset Council wanted the new Keynsham Civic Centre (KCC) building to be a truly sustainable office. It was aware the performance of many new schemes that aspire to be green falls short of the design intent, but the council wanted to show it is possible to deliver a low carbon building within a local authority budget.

'The value of KCC is to demonstrate our leadership on sustainable construction, which then strengthens our function as a planning authority,' says Micaela Basford, corporate sustainability officer at the council.

For the KCC building, Max Fordham and architect AHR set out to design and deliver a low-energy building that would perform as designed. Accordingly, the project targeted an 'A' Energy Performance Certificate (EPC) rating and, critically, an 'A' Display Energy Certificate (DEC) for building energy in use.

Now, more than two years after it was first occupied, the project is performing as designed – well, almost. The low-energy design achieved an 'A' EPC, but its DEC rating is currently 'B' – although this may be improved with further energy reductions under the project's soft-landings framework.

The building's impressive low carbon achievements – and even lower carbon aspirations – were recognised by CIBSE last year, when it won Project of the Year (Public Use) at the 2017 Building Performance Awards. The judges said the project showed 'good focus on performance objectives... with strong collaboration from the outset in the project team'.

## Passive approach

To deliver an office that was low energy in use, Max Fordham adopted a 'passive first' approach to the architectural and services design. Based on lessons the consultant has learned from previous projects, this approach develops the building's form and designs its fabric to work so hard that much of the mechanical plant – which is costly to install, operate and maintain – is unnecessary.

As a result, the four-storey civic centre's principal façades face north and south, to help control solar gains. Larger windows were created on the north-facing elevation to allow

in large amounts of daylight without a direct sunlight component. The smaller windows on the southern façade have been fitted with light shelves, to provide shading and enable light to be bounced deep into the floor plates.

Surprisingly for a noisy town-centre site, the offices are naturally ventilated. Rather than use opening windows, however, the floors are ventilated via a series of acoustic louvres integrated into the window frame. These are separated from the offices by two insulated panels. The smaller top panel opens under the control of the building management system (BMS) to give ventilation during the day and allow night-purge ventilation; the larger, lower panel can be opened by the occupants for additional ventilation when needed.

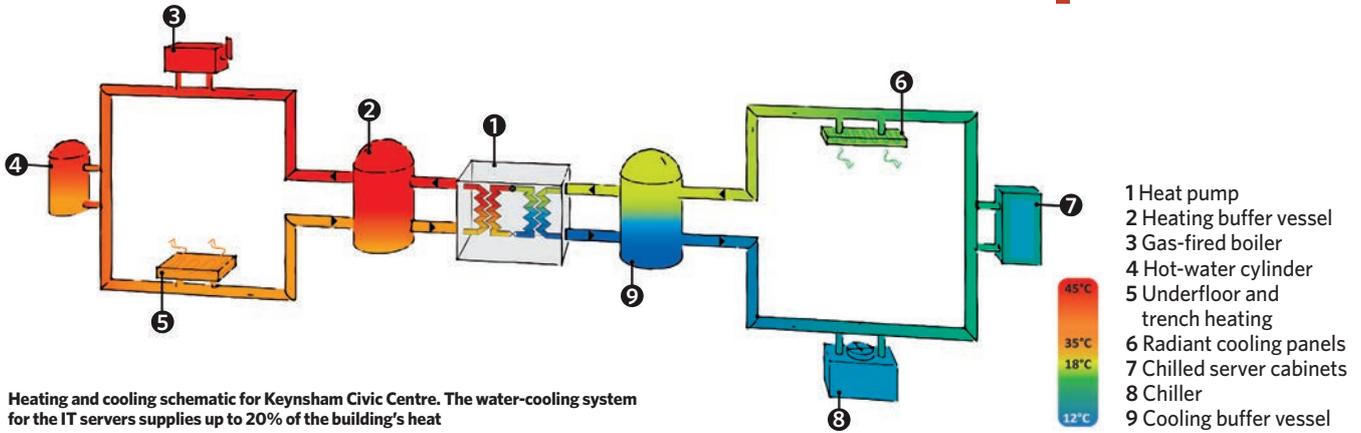
This strategy is helped by the building's narrow, 15m-wide floor plates and split-pitched roofs, which incorporate high-level opening, clerestory windows. These allow warmed air to rise up and out of the building. The designers have also taken advantage of the pitched, south-facing roof to install a 1,150m<sup>2</sup> photovoltaic array.

The building's structure has also been designed to complement the natural



The civic centre is ventilated via acoustic louvres integrated into the window frames





Heating and cooling schematic for Keynsham Civic Centre. The water-cooling system for the IT servers supplies up to 20% of the building's heat

ventilation strategy. It comprises a steel portal frame with a cross-laminated timber infill, to minimise embodied carbon. To add thermal mass, precast concrete floor planks have been incorporated into 50% of the building's floor area, to absorb heat during the day. This is then purged at night, when outside temperatures are lower.

To future-proof the building against the anticipated effects of climate change – and to enable increases in occupant density – cooling pipework has been cast into the concrete planks, for connection to a future chilled-water circuit. Winter heating is from the water-cooling system for the IT servers. This supplies up to 20% of the building's heat

**“To future-proof the building against climate change, cooling pipework has been cast into the concrete planks”**

via a heat pump. A constant-temperature circuit serves the underfloor heating system, while a variable-temperature circuit serves the perimeter trench heaters, to prevent down-drafts from the windows. Top-up heat is provided by gas-fired boilers.

The lighting has been carefully designed to save energy. In circulation areas, it dims automatically in response to increased daylight levels, while presence controls turn lighting off in unoccupied areas. Task lighting is supplied by floor-mounted units, controlled by occupants. The lights can be switched off as a group when daylight levels reach 500 lux, or when local zone switches are activated on a particular floor.

Power to the floors is metered, with the floorplates subdivided to aid identification of anomalies. ‘The building uses building physics, rather than being based on complicated technology. There was no financial uplift for it to be built to high energy-performance levels and it is a nice working environment – all of which makes me proud to show people around this public sector building,’ says Basford.

‘As a member of staff, the wellbeing aspects of the building are also important to me. Apart from providing lots of natural light to the building, the windows have opened up some fantastic and alternative views of Keynsham and its surroundings, including lots of greenery.’

**Soft landings**

The scheme uses soft landings, so the designers and the constructor, Willmott Dixon, have remained involved with the building after completion, to fine-tune and de-bug systems, and help occupiers to best manage what has been delivered.

Willmott Dixon is responsible for reviewing the building's actual energy performance on a month-by-month basis, to identify where it differs from the energy budget. The project team then works together to further optimise the building's performance. It is an approach that appears to be working, if a little slowly.

Tamsin Tweddell, senior partner at Max Fordham, said: ‘After a period of learning with the building in use, we have identified ways to further refine the systems – in particular, the controls for the heating and natural-ventilation systems.’ There has been ‘meaningful progress’ in the past three months, she added, with energy consumption expected to fall as a result. Table 1 shows how energy consumption is falling over time, as the systems are optimised, and the team continues to progress towards the DEC A-rating target. **C**



Table 1: Energy/gas use and PV generation over time

	Electricity use	Gas use	PV generation
Nov 14 - Oct 15	82kWh/m <sup>2</sup>	37kWh/m <sup>2</sup>	217MWh
Aug 15 - Jul 16	70kWh/m <sup>2</sup>	31kWh/m <sup>2</sup>	196MWh

Keynsham Civic Centre's energy consumption is falling as systems are optimised

# QUALITY CONTROLLER

To ensure projects are value for money and completed to a high standard, Anglia Ruskin University has a clerk of works. Liza Young finds out what the role entails

**T**he cost per year of a clerk of works is cheaper than a day in court. This quote, by barrister Tony Bingham, has never rung more true than it does today, says Jerry Shoolbred, who fulfills the role at Anglia Ruskin University.

He cites Dame Judith Hackitt's interim report on building regulations and fire safety, *Building a safer future*. In it, respondents raise concerns about the prevalence of value engineering, and outline the need for the increasingly uncommon role of a clerk of works as an onsite quality control function.

'I would like to think that, had one been employed at Grenfell, he or she would have made sure the materials were as the drawings and specification, and that the non-combustible cladding specified was the one that ended up being installed,' says Shoolbred. 'A clerk of works – or quality control officer – really adds value to a job.'

The role entails ensuring projects achieve value for money and are completed to a high standard in terms of workmanship, materials and construction.

Shoolbred liaises with mechanical, electrical and sustainability engineers to ensure services are installed correctly, and helps to protect the client's interests throughout the construction process to get the project right first time. This is essential at a university that has campuses in Cambridge, Chelmsford, London and Peterborough. The Cambridge campus is home to one of only nine optometry schools in the UK while, in Chelmsford, the university has embarked on an ambitious programme of development, with the School of Medicine due to open in September.

## Experience

Shoolbred has been a clerk of works for 40 years, and has worked at Anglia Ruskin University for the past 14.

Interestingly, he started his career in



Jerry Shoolbred at the new science building at Anglia Ruskin University

the same place in the 1970s, when he completed a carpenter and joiner apprenticeship at Cambridge College of Arts and Technology. This later joined forces with Chelmsford College, became Anglia Polytechnic and, eventually, Anglia Ruskin University. 'It's nice to come back and see how the place has changed,' Shoolbred says.

As the university expands, every two years or so, he gets to work with a new set of contractors and consultants. 'From every job we do, we pick up what we've learned – and what didn't work – and take that through to the next job,' says Shoolbred, whose experience means he can identify potential issues and suggest alternative methods or mitigation techniques.

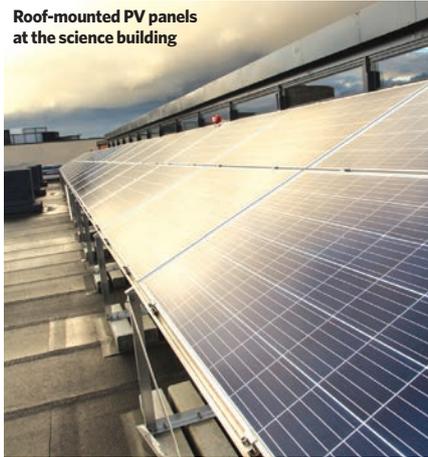
'[Racehorse trainer] David Brown once said that racing improves the breed. That works here as well; every time we produce another building – or bring another on stream – we've learned from previous projects, so try to build better and sensibly,' he says.

As clerk of works, Shoolbred follows a project from inception to decommissioning. 'I see where the drainage and utilities go in at the front; I see the structure of the building go in; and I'm there at handover, dealing with defects,' he says.



Shoolbred keeps a site diary on all projects

Roof-mounted PV panels at the science building



He also endeavours to get involved with new projects at the design stage. 'I use my experience to give my professional opinion and make recommendations for alternative approaches – whether it's the best choice of entrance mats or the preferred type of lights, and where things can go wrong.'

### Quality control

Shoolbred ensures he sits in at the early stages of design, as a quality control element, so the university's needs are embedded in the design. He has a focus on quality, promoting right-first-time initiatives, to help reduce rework and double-handling.

'The clerk of works' role is to read through all the drawings from the contractor, architects and consultant – as well as the specifications – and make sure the contractor isn't taking any shortcuts,' says Shoolbred.

'You have to be very open with the contractor, who should be prepared to give you the agreed drawings and specifications upfront, as soon as possible.'

Towards the end of a particular trade package, Shoolbred produces a list of defects. 'When I see something wrong, I'll flag it up straight away, because construction times are so tight nowadays. We have to make sure it's built properly, so we don't have any long, drawn-out snagging lists at the end,' he says.

Most of the projects at the university are procured through design and build, so Shoolbred tries to influence any derogations or value engineering. 'I spend a lot of time trying to put back what is being stripped out [from the specification] – and that's not always easy because I have to take into account quality, time and cost.'

'There have been many occasions [in my career] when I've been working on site and a particular handrail detail I expected to see has changed to a flimsy bit of string, because the cost managers have got in there and toned it down. I'll then fight to make sure they put back the original.'

As a clerk of works, Shoolbred doesn't have any budget of his own, and is entirely dependent on the major projects and the maintenance teams. 'I'll make recommendations as it suits and fits, while still having my site quality control hat on, so the client gets what they pay for,' he says.

By looking at things from a maintenance angle, Shoolbred is able to bring a different perspective to the table. 'Because our buildings are so well used – there might be classes from 8am to 9pm, for example – there's very little downtime on any of them, so we have to include as many maintenance-free practicalities as we can.'

### WHAT IS A CLERK OF WORKS?

The Institute of Clerks of Works and Construction Inspectorate defines the role as a 'person whose duty is to superintend the construction and maintenance of buildings, or other works, to ensure proper use of labour and materials'.

A clerk of works represents the interests of the client by ensuring the quality of materials and workmanship are in accordance with the specification and engineering drawings.

The job title is believed to derive from the 13th century, when monks and priests took on the responsibility of supervising works associated with building churches. As craftsmen and masons became more educated they took on the role. By the 19th century, it had expanded to cover the majority of building works.

Before the mid-1990s, most local authorities employed teams of clerks of works within the architects and engineering department. After the recession of the 90s, however, cutbacks resulted in professional services being outsourced to facilities management companies, and clerks of works were not replaced after retirement.

#### Their duties include:

- Inspecting buildings for safety and structural integrity
- Overseeing workmanship to minimise problems and rework
- Inspecting materials to ensure they are correct, suitable and of appropriate quality
- Checking for – and minimising – defects
- Giving recommendations to the client throughout construction

### Recording and reporting

As well as the university's commissioning engineers, CML – which regularly reports any defects to the clerk of works – Shoolbred says the university relies on its maintenance department. These experienced mechanical, electrical and sustainability engineers work alongside the contracted teams during every project. 'They've been around – they know what works and what doesn't work – so they have an input throughout,' he says. >>

**"From every job we do, we pick up what we've learned – and what didn't work – and take that through to the next job"**



A lecture theatre at the science building

» The department has regular projects and M&E liaison meetings, with all the project building officers, clerk of works and maintenance engineers in attendance, to ensure information is readily and easily shared. ‘Sometimes talking saves no end of emails,’ says Shoolbred.

To make sure nothing is missed when services go on site, Shoolbred keeps a site diary. ‘More importantly, I take loads of photographs – of things in ducts, in cupboards and under the ground, and of connections into the building,’ he says. ‘That way, I have a record of it – because, sooner or later, it will be lost within risers, which will be lost within floors.’

‘I want to make sure I’ve seen that it’s been put in properly and that it hasn’t been damaged before going in. Otherwise, the contractor has to come back to put things right, which might mean further downtime.’

Before handover, Shoolbred ensures the maintenance team familiarises itself with the building.

‘We’ll arrange a series of training days with the contractor and subcontractors,’ he says. ‘There’s nothing like listening to what a technician is telling you, so you can hammer them with questions.’

Every contractor must also provide an asset list – a building information model that includes every item, from air handling units to filters and pumps, which are all asset tagged. Like the old planned preventative maintenance chart, this list includes information on every mechanical and electrical element within the building, including the model number, cost, when it is expected to fail, and how much use it is likely to get.

‘This gives you an idea of when an asset might go wrong, so you can include the cost of replacing it in your budget,’ says Shoolbred. ‘We can work with our maintenance colleagues to plan ahead, ensuring our engineers and contractors are there to look after various building services.’

### Essential on site

Shoolbred believes saving money is the main reason the clerk of works role has all but disappeared. ‘There’s no doubt that having a clerk of works on site makes a difference,’ he says.

‘They have the experience of seeing a project at the front, all the way through to the end. They know what’s gone into the ground, and they can hand it over to their clients and do the aftercare – as I do at the university. I stay on a project throughout the 12-month defects period and do the coordination and liaison, so clients know there’s a face they can come to if there’s a problem.’

Shoolbred believes clerks of works would not only save clients money, but would help ensure projects are delivered with safety in mind. They have the ability to anticipate, interpret, record, advise and help reduce risk, while providing guidance on health and safety, he says.

If a client employed a clerk of works, they would have fewer problems down the line, he adds, because they are impartial, with a fair and independent approach to ensuring value for money for the client.

‘But, mostly,’ says Shoolbred, ‘a clerk of works reports the facts.’ **CJ**

Shoolbred stays on a project throughout the 12-month defects period



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Warren Buffett

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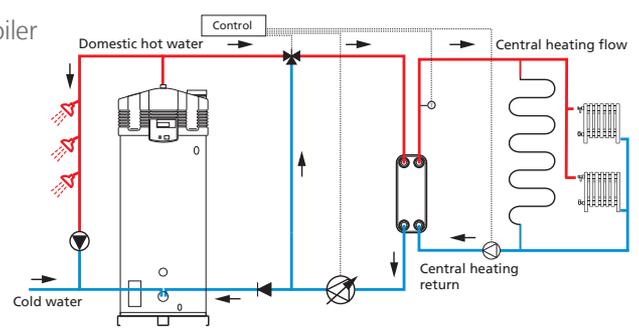
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### How do installation engineers benefit?

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## Work starts on giant ground-loop system

**Project will feature 16 shared ground-loop systems serving eight tower blocks**

A project to build England's largest shared ground-loop heat pump system has received planning permission. Once completed, it is expected to reduce the energy bills of residents in eight tower blocks in Enfield, London, by up to 50%.

Groundworks have already started on the scheme, which will serve 400 flats via individual heat pumps connected to the 16 ground-loop systems, installed by Kensa Contracting and French utility firm Engie.

Each district system will consist of clusters of eight boreholes, serving individual heat pumps in the flats. As well as minimising drilling costs, the shared set-up also allows residents to choose their own energy supplier and secures funding through the Energy Company Obligations



(ECO) scheme and the Renewable Heat Incentive (RHI).

'One of the strengths of this system type is its flexibility and scalability,' a Kensa statement said. 'Shared ground-loop systems can be featured in developments of just two properties [micro-district], while this project clearly shows how the concept can be scaled up to much larger systems.'

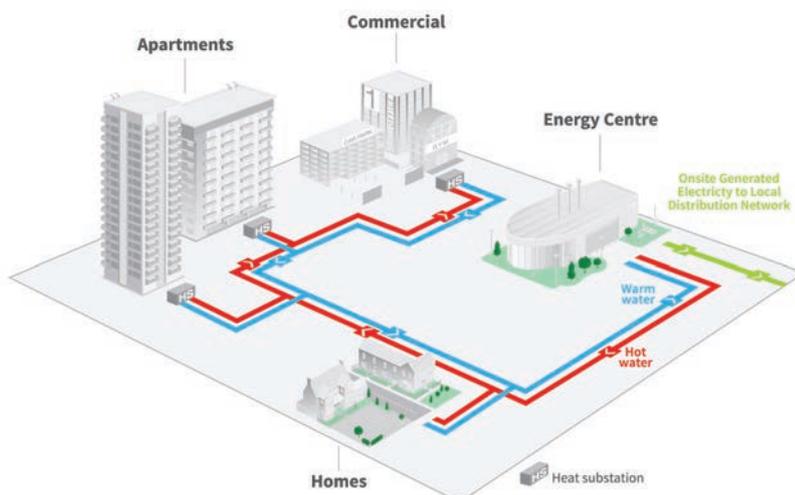
## New district energy network for Uxbridge development

Metropolitan, and partner Vital Energi, will design, build and operate the district energy network for St Andrew's Park, near Uxbridge, in the London Borough of Hillingdon.

The development has more than 656 homes and 30,000m<sup>2</sup> of commercial space, including a hotel, care home, theatre and offices. The contract, awarded by St Modwen Properties and Vinci, is to supply low carbon heat to all the buildings on the site.

Metropolitan will own and operate the heat network and a gas-fired combined heat and power energy centre. The solution will provide a 30% saving on carbon emissions, compared with supplying heat from boilers in homes. This will help the development meet the zero carbon requirement in the London Plan, and the mayor's stipulation that decentralised systems will generate 25% of the heat and power used in London by 2025.

A temporary energy centre will supply the initial 350 homes until the main energy centre is completed in 2021. Heat interface units with smart local displays will allow customers to keep track of how much heat they are using, while Metropolitan will be able to bill customers on actual real-time readings.



## Viessmann fuel cell gathers Pace

Viessmann has announced that it has cut the price of its fuel cell boiler by 45% with help from the European Pace grant scheme, which aims to facilitate the installation of at least 2,500 fuel cell micro-cogeneration units in Europe by 2021.

The manufacturer claimed cutting the price from £18,000 to £9,990 made the first mass-produced fuel cell boiler as affordable as a heat pump, with the added benefit of producing electricity as well as heat.

With MCS certification, the Vitovalor 300-P entitles owners to claim up to £6,000 over 10 years - or 13.6p for every kWh of power - from the UK government's Feed-In Tariff.

It comprises a fuel cell unit, peak load boiler and hot water tank in a single, compact unit. The polymer electrolyte membrane (PEM) fuel cell, which converts gas to hydrogen for its energy source, generates up to 15kWh of electricity per day.

## Heating costs halved at church

Heating costs at St Plechelmus church in Deurningen, The Netherlands, have halved since a gas-fired air heater was installed, according to Mark Climate Technology.

The high-induction supply air system ensures hot supply air is introduced into the church at high velocity. The air outlet plenum has rubber nozzles that are tuned to generate an optimal pattern for the supply jets, and the high induction rate creates the required mix of supply air and room air. The desired room temperature can now be reached within one hour - rather than half a day, according to the company.

## MHS founder dies

Founder of MHS Radiators John Bradley has died, aged 82. Bradley's 50-plus years in the heating industry began in the 1970s, when he was made general manager of Hamworthy Heating. He co-founded Modular Heating Sales (MHS) in 1980, and MHS Radiators and MHS Boilers soon became firmly established in the UK.

Bradley's son Ian, MD at MHS Radiators, said: 'John's entrepreneurial approach, work ethic and eye for a deal will be fondly remembered - he was one of the great characters of our industry.'

## New single-fan mini-VRF unit from Mitsubishi Electric

Mitsubishi Electric has launched new single-fan air conditioning units, offering variable refrigerant flow (VRF) in the company's smallest City Multi chassis. Known as mini-VRF, these systems offer multi-room heating or cooling for projects less than 20kW according to the company.

The units have been developed because developers are being increasingly constrained by equipment costs and limited space, said Mitsubishi Electric. 'These new models are ideal for boutique hotels, retail and high-end designer outlets, as well as mixed-use buildings, where the siting, noise level and the height of the outdoor unit can sometimes pose a challenge,' said product specialist Jordan Jeewood.

Available in 12.5kW, 14kW and 15.5kW, up to 12 indoor units can be connected to the R410A models, which are 10% cheaper than Mitsubishi's equivalent double-fan PUMY, and offer a 27% reduction in both height and weight, according to the company which plans to launch three-phase models in May.

## Airedale co-founder Midgley dies

Leeds-based air conditioning manufacturer Airedale International's co-founder Peter Midgley has died.

He set up Airedale with Alan Duttine OBE in 1974, and remained joint managing director until the sale of the business to Modine Manufacturing in May 2005.

In a statement, Airedale said Midgley will be remembered by customers and for his larger-than-life character. Well known throughout the region and industry, he was a people person - approachable, warm, and with an infectious sense of humour, said the statement. It added that Midgley had led the business for more than 30 years, and saw it grow into a major manufacturing company, contributing significantly to the local and national economies.

Airedale managing director Tony Cole said: 'Many of our employees have worked in the company since the early days and benefited from Peter's and Alan's approach of investing in people. They and I will remember Peter fondly. We send our deepest sympathies to his family at this very sad time.'



## Iconic Hoover building cooled by Fujitsu

### Residents manage and monitor their systems using Wi-Fi controls

Fujitsu has installed 66 compact variable refrigerant flow (VRF) systems at the iconic Hoover Building in Perivale, west London.

Built in the 1920s as The Hoover Company's factory and headquarters, the Grade II property has been converted into 66 studio, one-, two- and three-bedroom apartments. The building was acquired by IDM Properties in 2015, and the company worked closely with English Heritage and the London Borough of Ealing to ensure the art deco features of the property were restored and preserved.

The heating and cooling in each apartment has a seasonal coefficient of performance (SCOP) of more than 5.81, according to Fujitsu.

HVAC/mechanical services company Carter Devlin - trading as Apex Technical - managed the heating and cooling systems. As planning restrictions limited the height of outdoor air conditioning

products, Fujitsu's VRF units were specified because of their compact size and flexible piping design. These serve multiple slim ducts in each apartment.

Carter Devlin installed the Fujitsu two-pipe VRF systems, together with IntensisHome Wi-Fi controls, enabling residents to control and monitor their air conditioning systems remotely via their mobile devices, from anywhere in the world.

Matthew Barnett, director at Carter Devlin, said: 'As this was the refurbishment of an existing, listed building, flexibility was key. The demands of the client's design team, and the nature of the work, required a system that could be adapted to suit fluid and changing needs.'

'The ability to change the orientation of the universal ducted units supplied was vital in providing a quality product and onsite flexibility.'

## Daikin redesigns VRV water-cooled series for COP of 6.50

Daikin has released an upgrade to its water-cooled variant refrigerant volume (VRV) range. The VRV IV W + series uses lower refrigerant charges, in line with EN378 regulations, according to Daikin. It is a compact unit, with geothermal operation, variable refrigerant temperature and a two-stage heat recovery operation. The + series also offers a greater range of capabilities, said Daikin, with up to 14HP (40 kW cooling capacity) in single modules and up to 42HP (120 kW cooling capacity) in multi-combinations.

Water-cooled VRV heat dissipation



Daikin has redesigned the VRV product using materials and manufacturing processes that, it said, have pushed the coefficient of performance (COP) of its VRV series to 6.50. A heat exchanger twice as big as the current model helps achieve this efficiency, according to Daikin.

The VRV is connected to the latest Daikin Emura and other residential indoor units, hot-water hydro boxes, air curtains and ventilation, so users can enjoy draught-free comfort.

The firm said its zero heat dissipation technology allows the system to be kept at a constant temperature without an external cooling source. It claimed simple-to-remove side and front panels meant there is no need to remove the refrigerant piping, while a rotating switch box and connections at the top of the unit allowed easier access to all major components.

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Integrating biomass boilers with fossil-fuelled ones creates issues for systems design. In his second article, **David Palmer** outlines the mathematical modelling needed to inform design decisions



# BOILERHOUSE BLUES – AND HOW TO AVOID THEM

**T**he successful integration of a biomass boiler with fossil-fuelled boilers requires an in-depth understanding – informed by measurement and calculation – of the performance and shortcomings of the system into which it is being installed. Simply connecting a biomass boiler in parallel with a conventional system can result in flow-temperature dilution,

flow sharing, and power-output limiting. Any one of these problems is often accompanied by one or both of the others, and only in a properly understood, designed and balanced system can they all be avoided.

## Flow-temperature dilution

The problems of flow-temperature dilution were explained in *GIR40: Heating systems and their control*<sup>1</sup> (see Figure 5), and extended by me in ‘Talking Headers’ (*CIBSE Journal*, February 2014)<sup>2</sup>. It occurs when the bypass flow from offline boilers mixes with the output from firing boilers, and when the total flowrate on the load circuits is greater than the boiler primary loop flowrate. For a complete description, refer to these publications.

## Flow sharing

When only fossil-fuelled boilers are installed, the individual contribution from each boiler is of no concern to the end user. When a biomass boiler is included, however, its maximum output is required for financial and carbon-reduction reasons.

Many biomass boilers have been added to existing systems, and Figure 1 shows a typical schematic in which only the biomass boiler is firing and supplying the full load. When a fossil-fuelled boiler is also firing, however, the load will be shared between the active boilers, in the ratio of the flowrates through the boilers. In this case, the 400kW boiler will supply 57% of the load –  $400kW / (400kW + 300kW)$  – and the biomass boiler 43% (see Figure 2).

However, if the fossil-fuelled boilers operate at 11°C temperature differential ( $\Delta T$ ) on a load system designed to operate at 11°C  $\Delta T$  while the biomass boiler is set to operate at 20°C  $\Delta T$  – a not infrequent finding – the biomass contribution will reduce to 29%. Temperature dilution will also occur on this circuit if the total primary flowrate is less than the total secondary flowrate. The simple remedy is to connect

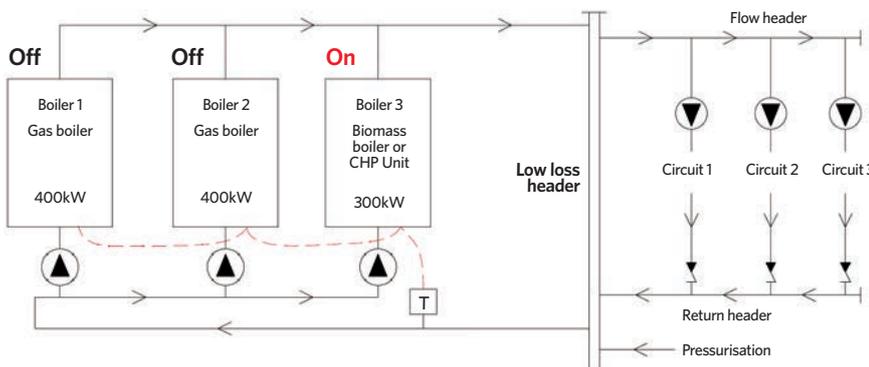


Figure 1: Hybrid boilerhouse with only biomass boiler firing

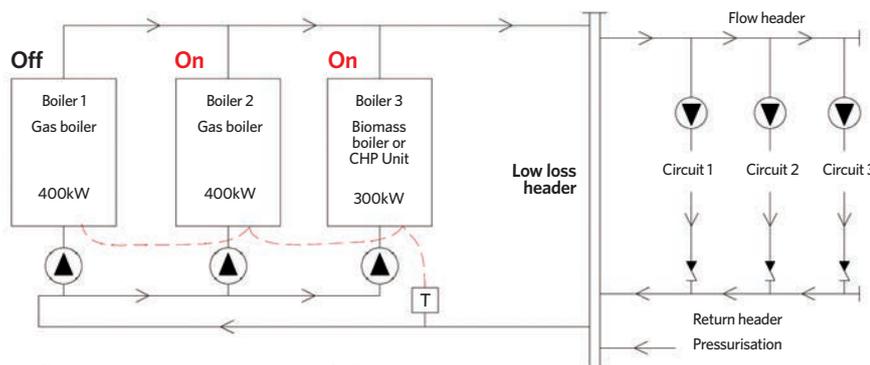
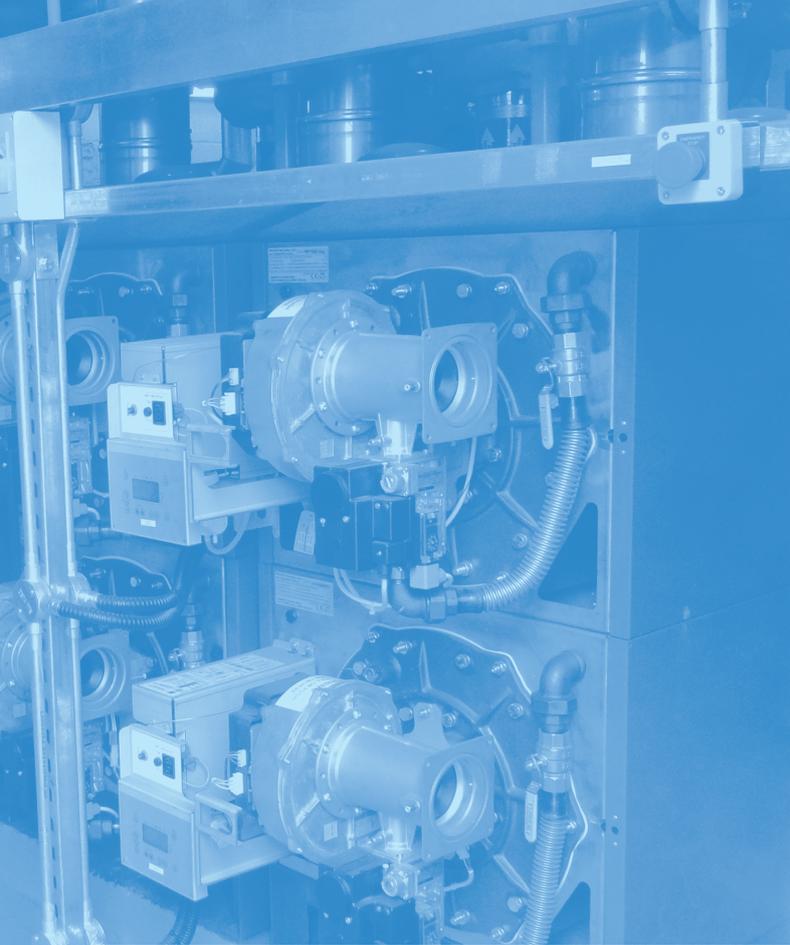


Figure 2: Fossil-fuelled and biomass boilers both firing



the biomass boiler in series injection with the system return, as detailed in Figure 3.

Flow sharing is the most common reason biomass boilers fail to supply their potential output, and was found in 50% of the systems surveyed. The worst case was a 2.1MW boiler supplying only 42% of its output, with the consequential loss of more than £30,000 per year in Renewable Heat Incentive (RHI) income.

**Power-output limiting**

The most common symptom of power-output limiting is that a boiler is unable to supply its full output. Taking measurements of flowrates and temperatures, and then doing a simple mathematical analysis, is the only certain way to identify when power-output limiting is occurring.

The example below is for a system in which the biomass boiler has never – and will never – achieve its full output. It is important to understand the load system  $\Delta T$  always determines the boiler  $\Delta T$ . The problem arises when the maximum load  $\Delta T$  is less than the design  $\Delta T$  of the biomass circuit. On this system (Figure 4), the lowest biomass design  $\Delta T$  achievable is 14.2°C<sup>3</sup>, with the pump at maximum speed, whereas the maximum load  $\Delta T$  is 8.5°C. This limits the boiler output to 8.5/14.2 = 60%, or 120kW. Loads above this value are met by LPG boilers, resulting in an under-used biomass boiler.

The solution is to increase the flowrate of the biomass boiler pump – which requires a pump upgrade – to achieve a minimum flowrate of 5.63kg/s at a design  $\Delta T$  of 8.5°C. However, the issue with many systems is that the load circuits never return their design  $\Delta T$ . There are many possible reasons for this, but a solution to rectify a load  $\Delta T$  that is too low may be more complex and costly than pump replacement.

**Boilerhouse modelling**

The key to identifying and understanding these problems is to measure and model. Measurement of temperatures throughout a system is straightforward, but measurement of flowrates at all key points is equally important. These need to be repeated for each combination of boilers and load circuits that are likely to be used. Well-specified systems will have orifice plates and commissioning sets that allow the direct measurement of flowrates. Where RHI heat meters are installed, some

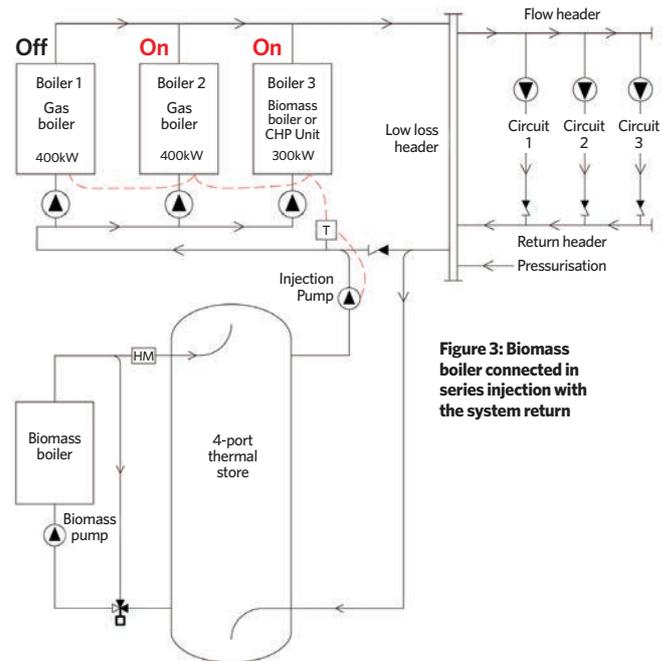


Figure 3: Biomass boiler connected in series injection with the system return

of the flowrate data can be read directly and, failing this, clamp-on flow meters can be used.

My approach is to draw a schematic of the system in Excel and populate it with data at each point of the system. Temperatures and flowrates are then calculated at each mixing node – that is, at the biomass boiler back-end

**“Many biomass systems have been abandoned, while others continue to underperform because the reasons for this are poorly understood”**

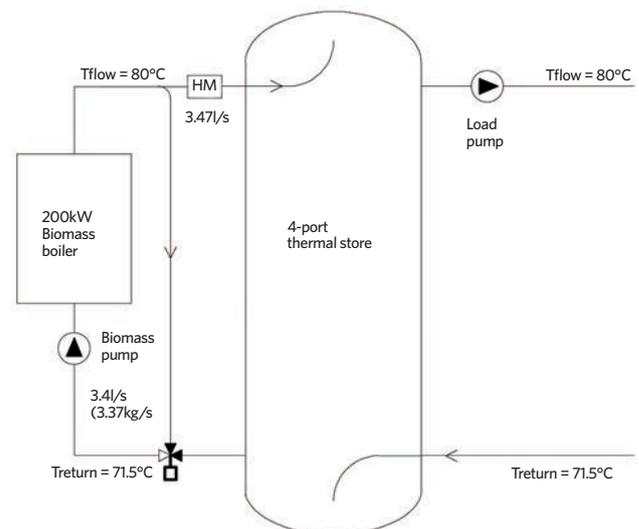


Figure 4: Biomass system with data showing how power output limiting can occur

valve and the flow-mixing valve in the simple example in Figure 5. This approach allows the examination of different operating scenarios, from which the problems of temperature dilution, flow sharing and power-output limiting can be identified and quantified. Using the model, input parameters can be varied to determine the system changes required to eliminate the problems identified. This methodology has been applied on boilerhouses of up to 8MW containing multiple boilers – including biomass – and with many load circuits.

**Practicalities of system remediation**

My article in the November 2017 *Journal* covered flue upgrading and replacement – which may or may not be possible, depending on system geometry and planning considerations. Remediation of systems with hydronic configuration and sizing problems is usually more straightforward.

For underperforming parallel-connected systems, pipework will have to be changed to convert the system to series injection, and an algorithm will be required to control the rate of heat injection into the return header. Pump upgrades may also be needed, as will system recommissioning, based on outputs from the boilerhouse model. When boiler seasonal efficiency is low – and/or the boiler is oversized significantly – a better option could be to install a smaller boiler.

**Covering remediation costs**

Many biomass systems have been abandoned, while others continue to underperform because the reasons for their under- or non-performance are poorly understood – plus,

**“The worst case was a 2.1MW boiler supplying only 42% of its output, with the consequential loss of more than £30,000 per year in RHI income”**

there is a lack of funding for rectification work. Several options are available for biomass-system remediation, including a:

- Paid-for analysis and repair service, offered by many companies, which may not be suitable when capital funding is required
- System-replacement agreement to provide a more appropriate boiler, with ongoing costs going into an energy service company (ESCO), and with possible RHI transfer to a finance company
- Biomass RHI transfer arrangement, to allow re-financing of a boiler by transferring boiler ownership and the RHI to a finance company. Boiler maintenance and fuel would be included in the last two options. Alternatively, an unwanted boiler could be bought with RHI transfer for re-use elsewhere, attracting a higher second-hand value than the boiler alone.

**Summary**

This article, and my previous one, have described the findings of detailed surveys of biomass boiler installations, the key reasons for biomass boiler underperformance, and the measures required to rectify significant deficiencies. Improvements to flues, thermal storage, and hydronic arrangements will address many of the issues identified.

The final article in this series will focus on the findings of surveys of conventional boilerhouses, the results of system hydronic analyses, and the measures implemented to correct the significant defects and shortcomings identified. **C**

**Notes**

1. Available to download from [bit.ly/2FcUGDc](http://bit.ly/2FcUGDc)
2. Available to download from [bit.ly/2End8aT](http://bit.ly/2End8aT)
3.  $14.2^{\circ}\text{C} = 200\text{kW} / (4.18\text{kJ/kgK} \times 3.37\text{kg/s})$

■ **DAVID PALMER** is a director of the Campbell Palmer Partnership and principal author of CIBSE AM15: *Biomass heating*

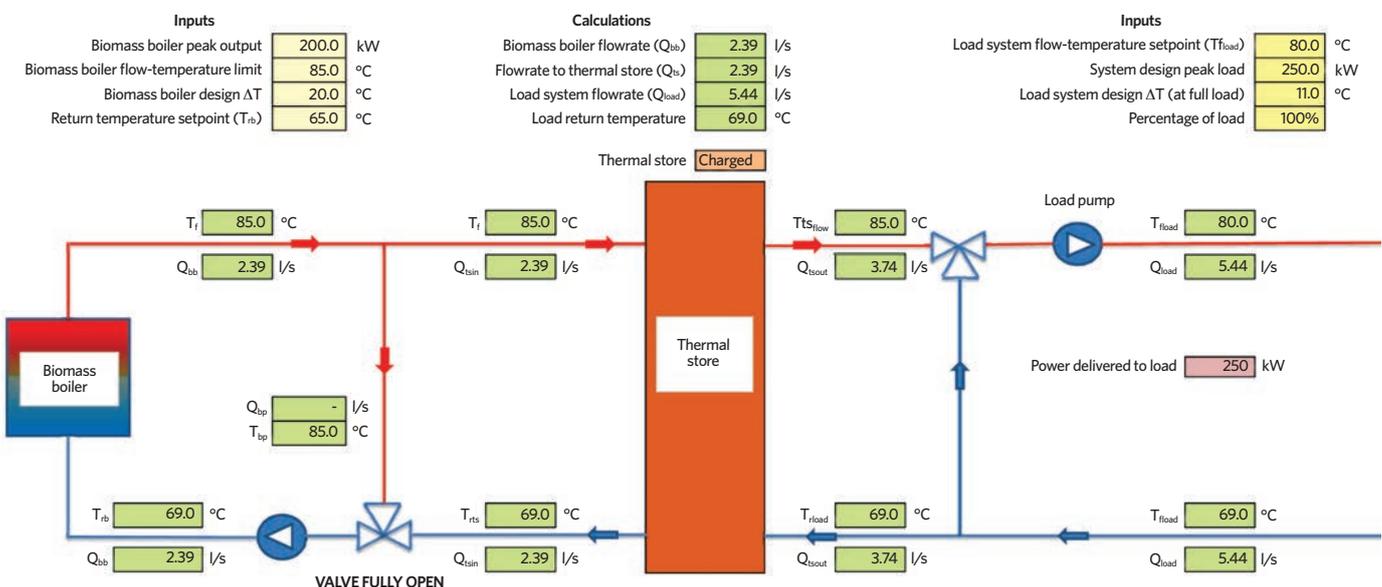


Figure 5: Simple boilerhouse model implemented in Excel

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■ MORE CLIENTS ARE USING DATA ANALYSTS TO NUMBER-CRUNCH THEIR WAY TO BETTER HVAC PERFORMANCE, AS THE FOLLOWING CASE STUDIES DEMONSTRATE

# NETWORK HEAVEN

Using data to analyse performance of a heat network enabled The Guinness Partnership to cut annual energy bills by £65 per dwelling in one pilot project. This convinced it to create strict performance requirements for future projects, as **Alex Smith** found out

**A**ffordable homes provider The Guinness Partnership (TGP) is a major supplier of heat in the UK. It has 150 heat networks supplying more than 4,500 homes. In the past three years, TGP has focused on improving the performance of its heat networks in a bid to increase customer satisfaction and cut costs. 'Our networks were significantly more expensive to run than we expected,' says Victoria Keen, head of sustainability at TGP, 'which meant we were exposed to the risk of financial losses.'

'A new approach was needed, and we spent a lot of time reviewing where we needed to change. To get better at being a supplier, we realised we had to think about how we acted as a customer when networks were being built.'

Procuring the right equipment and advice – and setting performance requirements for the supply chain – were key to ensuring the heat networks operated at the correct levels, says Keen. To understand why they were costing more to run than expected, TGP worked in partnership with energy consultants Guru Systems and FairHeat to measure the performance of a heat network at one of its developments in London's Elephant and Castle. Funding for the pilot project at the 140-unit residential block in Stead Street was provided by the Department for Business, Energy and Industrial Strategy (BEIS).

Guru Systems installed smart meters and extracted real-time data from the system using its Guru Pinpoint software. For the first time, TGP could see how well the network was actually performing compared with predicted performance. This offered the partnership and its contractor a chance to identify any technical issues before properties were handed over to customers. 'The commissioning phase is a critical period for performance testing, allowing issues to be identified early on so they are easier and cheaper to fix,' says Keen. After the pilot, commissioning testing was rolled out to the rest of the Stead Street network.

The project ran against the backdrop of a government report that shows about half of the performance gap on heat networks is because of poor commissioning, with the other half down to poor design. Casey Cole, managing director at Guru Systems, said the data helped identify how much heat-network performance could be uplifted through commissioning, the cost of carrying out improvements; and whole-life savings for the project.

As part of its commissioning support, FairHeat carried out acceptance testing before the dwellings were occupied by customers. 'The objective was to identify the causes of performance issues, and reduce short- and long-term risk

to the network operator,' says FairHeat managing director Gareth Jones. In the short term, Jones adds, the risks arise from costly revisits and poor customer experience, while – over the longer term – operators are exposed to financial losses because of expensive running costs, or having to subsidise higher-than-expected bills.

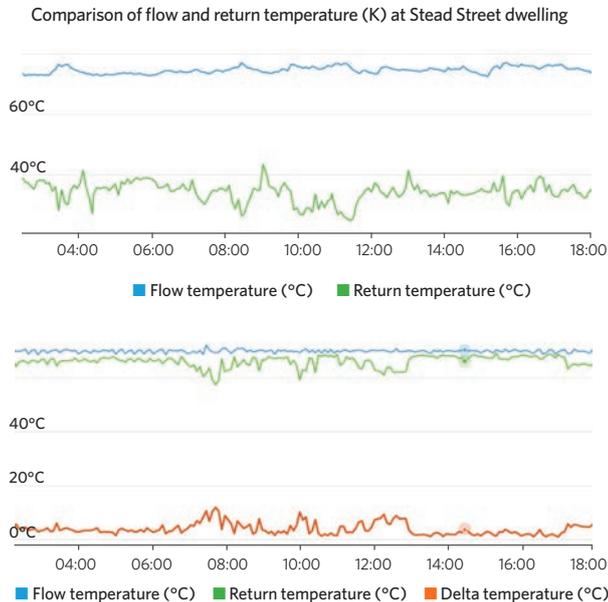
During acceptance testing, the team used performance data from Guru Systems' meters to isolate areas of inefficiency, and work with the contractor to carry out in-depth site investigations. These threw up a number of issues in key risk areas, such as resident comfort, regulatory compliance, low efficiency and post-occupancy call-outs. If uncorrected, these would have resulted in dissatisfied residents and significant ongoing costs, with a raised probability of overheating, says Jones.

Working in partnership with the contractor, TGP implemented a testing regime and prescribed changes. This has resulted in average return temperatures dropping by 22°C, leading to a reduction in losses from the return pipework of around 75%.

The testing and changes will deliver an estimated saving of £2,000 per block, per year, equating to £65 per dwelling. This is in addition to significant cost reductions associated with avoided call-outs and management time, says Keen. 'The detailed, diagnostic information

The Guinness Partnership's Stead Street property in London, where the pilot project took place





The top graph shows the desired temperature differences between flow and return temperatures at Stead Street, while the one below shows an inefficient system (on another project) with a low flow-return temperature difference

provided by real-time network performance data was critical to identifying technical irregularities and the causes of inefficiency. It was vital that these issues were spotted at a time when our contractors were on site.

Lessons learned – from Stead Street and other pilots – about the impact of data on network performance are now driving up efficiency across the heat-network sector, says Jones. ‘We started to see a familiar story. Suppliers had planned systems based on 70°C flow and 40°C return temperature, low losses and cool corridors, but soon saw from the data that they were getting something very different.’

Network performance levels were worse than expected, adds Jones, with corridors overheating and warm cold-water taps. ‘That is what drives up cost, impacts on customers, and exposes heat suppliers to risk,’ he says. Heat suppliers’ requirements of their contractors were not specific enough – and, says Jones, ‘there was no way to measure if they were being met’.

Cole adds: ‘There was a focus in the design stage to deliver abundance over efficiency – creating unnecessarily large networks that were costly to run. Big data has changed that, and allows providers to quantify performance and ensure standards are being met. Networks are performing significantly better – which is creating happier customers paying lower bills.’

### Lessons learned

TGP has now developed a design guide that sets out clearly its core principles for heat networks. The guide is based on *CBI Heat Networks: Code of Practice for the UK*, published by CIBSE and ADE, but gives specific objectives and performance criteria. It is supported by a commissioning guide.

TGP has also committed to carrying out acceptance testing on all properties before handover. ‘We even specify certain equipment choices,’ says Keen. ‘We wanted to know it can meet the performance standards we expect and is easy to maintain.’

Many of the problems stemmed from the design stage, and retrospectively trying to rectify these was costly. ‘Designs were oversized and overcomplicated – leading to higher capital expenditure,’ says Keen.

‘The design and commissioning guides allow us to take the lead, so contractors understand the performance standards we want to achieve. In the main, they create a better working relationship, because there is clarity on all sides.’ □



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# INSIGHT ONSITE

Carbon Credentials uses advanced data analytics to drill down into BMS data and optimise the performance of HVAC systems. Founder **Cian Duggan** explains

**I**n recent years, we have seen a dramatic growth in the accessibility and availability of operational building data, which – combined with technology – enables us to understand actual operation better than ever before. We have an amazing opportunity to use this to reduce the energy consumption and improve the performance of buildings significantly.

Often, however, information alone does not lead to action and success. Engineers working on the performance of existing buildings have seen this for many years; recommendations from energy audits don't get implemented and reports are created that just sit on shelves.

In 2015, we conducted more than 300 detailed building audits for clients under the Energy Savings Opportunity Scheme (Esos). Analysis of these surveys found that the majority of large commercial buildings in the UK have low-cost, quick wins available through building management system (BMS) optimisation and engagement – but the barriers to realising the savings are not always easy to overcome. To find a solution, we work with our clients to understand the situation faced by facilities managers, M&E engineers and BMS engineers.

First, we establish a continuous data stream from the BMS, sub meters and fiscal meters back to ADAPt – our big-data machine-learning-enabled platform – and analyse this data remotely using our collaborative asset performance programme (Capp). Overlaying profiles allows us to see how the plant is operating and to what signals/inputs it is responding. We compare this to the BMS 'description of operations' and insight from detailed site surveys, to make observations on BMS operating profiles that may be causing high energy consumption or poor building performance.

We then bring these observations to the site team and facilitate a discussion about what the observations might mean. Rather than focusing on what is going wrong, we look at what we can do together to make the building better. By combining the data and insights with the knowledge of the building manager and the M&E and BMS engineers, we can uncover opportunities that would not be possible through normal maintenance.

Once agreed actions are implemented, we conduct a measurement and verification process aligned to the International Performance Measurement and Verification Protocol to prove the impact and savings achieved. This is critical for financial stakeholders in



particular. The programme then moves into the maintenance and incremental improvement stage, where we continue to analyse data and report automatically if the building moves out of the new optimised state.

## Case study: 30-storey office building

One of the early adopters of Capp was an existing client who occupied a 30-storey office building. The operational requirements of the building had evolved over many years, but the core HVAC systems remained the same, with the addition of some automated controls. The building management team had made improvements to bring consumption down, but they could not understand why out-of-hours consumption was still so high.

Detailed analysis of the BMS data, captured by our data acquisition device, was combined with sub-meter electricity consumption data. It found that when the building switched to the evening control strategy – designed so fans only ran when staff worked late – it was actually supplying higher rates of airflow. Further analysis, and collaboration with the BMS contractors, revealed it might be an issue with the signals from the lighting-occupancy sensors; the lights were switching off, but the BMS was still recording occupancy.

We suggested a test to reset the signal – and it worked. We then persuaded the client to spend a few days resetting all the sensors; the result was a saving of more than £130,000 per year in overnight and weekend HVAC consumption. The saving was so significant because the local fans caused main air handling units (AHUs) to come on, which then called for heating and cooling out of hours – all to condition empty floors.

In complex buildings, a fault like this can be difficult – if not impossible – to spot without data collection devices giving

Carbon Credentials' posters encourage building users to consider how they can save energy





The Capp is on target to help Village Hotels save £600,000 per year

insight. Our software delivers near real-time snapshots every 15 minutes.

Information is only useful if it directs effort. It takes people who understand buildings and the systems that support them to work with technology to prioritise interventions. When resources are stretched, understanding how to use them most effectively is vital. It's essential to be confident that the whole team understands the risks and interconnectivity of the HVAC systems, and the impact on costs, comfort levels and equipment obsolescence. So, BMS suppliers and facilities managers, asset managers and energy managers, specialist engineers and tenants are all part of the solution.

### Case study: Village Hotels

Our relationship with Village Hotels started in 2011, when we were engaged on CRC reporting. In 2015, we supported on Esos – by which time we had four years of data and were able to understand, in depth, what was happening in its estate.

It became clear from site surveys and client engagement that the enthusiastic and knowledgeable maintenance managers did not fully understand how to optimise plant operations. The client understood that a building optimisation programme would support their staff in identifying issues in the system.

We are 12 months into the programme, and on track to deliver the target of £600,000 annual savings from electricity and gas consumption across the portfolio. General managers and maintenance managers have ongoing access to BMS data through our portal and are sent automated reports that help them respond to control issues and optimise plant operations.

Key to success in Village Hotels is engaging with everyone in energy management, not just the facilities and building managers. We gave the site team access to ADAPt, which presents real-time building data in a way that's easy to understand. It allows people running the building to respond to unexpected changes and helps explain what has been achieved.

### Summary

Bringing BMS and sub-metering data together allows us to see – deeply, accurately and in near real time – how the plant is working, and how much energy and resources are being used. The aim is to make savings by optimising HVAC comfort delivery, fault finding and energy use. By combining engineering understanding with data insights, building owners can strip thousands of pounds from their energy and maintenance bills.

Many clients are reaping the benefits of not just the initial diagnosis and implementation of quick wins, but also the ongoing 'eyes over' service. An example of this is a large multi-tenanted office building in London, where an error with the BMS caused one of its main AHU fans to set back to only 80% overnight, instead of 60%. Our automatic exception reporting alerted the company to this and it was able to resolve it within 48 hours. It sounds insignificant but, unchecked, this would have cost the site £15,000 per year. **CJ**



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It is always preferable to site new plant in the same space as its predecessor, but there are a number of challenges when replacing non-condensing water heaters with condensing models in a multi-storey, period building.

In Victorian and Edwardian buildings, the basement (under the building or ground level) or sub-basement (under an exterior walkway) are often big enough to accommodate plant and equipment. In modern, multi-storey buildings, however, underground basements are not always available because of the method of construction and the prime value of ground-level space. As a result, plant tends to be sited on the upper floors or on the rooftop. With this in mind, modern water heaters are designed to be more lightweight, compact and easier to service, with minimum service clearances.

Most modern water heaters are condensing units, designed to improve energy efficiency by transferring latent heat from the condensing of the flue gases within the heat exchanger. If such a unit replaces a non-condensing version, a new flue system will always be required because the flues are not compatible.

Gases discharged from the flue terminal are cooler and less buoyant than those of a non-condensing appliance and, usually, form a visible plume of water vapour. If the water heater is at the top of a building – as is often the case in a new development – it is easy to site the flue terminal so plumbing does not cause problems for the building, or become a nuisance to neighbouring properties and passers-by.

This is not necessarily the case when a condensing water heater is installed in an old building, especially if it is going into the basement or sub-basement. As the least lettable area, compared with other floors, it

is often commercially preferable to keep it as a plantroom and put new water heaters here. However, condensing heating technology was not around when these buildings were constructed, so specifiers have to think carefully about where to site the flue terminal, and overcome the challenges imposed by a historic building.

As with new developments, the flue terminal should be sited so that plumbing is not noticeable. It should also be kept away from the building, as the water vapour can cause surfaces too close to the terminal to become wet, which could lead to water ingress and damp issues. It shouldn't be located under a balcony, for example, or near opening windows and doors. »

## NEW KIT ON THE BLOCK

There are several challenges to be overcome when replacing non-condensing water heaters with condensing models in a multi-storey, period building, says Andrews Water Heaters' David Ridgway



Typical warehouse conversions in central London

» To meet these requirements, the flue terminal may need to be far away from the water heater, resulting in a long flue run. So the flue must be designed to be cost-effective and accessible, without taking up excessive amounts of space.

A long flue run can also make it more difficult to expel the products of combustion because of poor buoyancy. If financially viable, a fan dilution system can be employed to dilute the flue products to a safe level before they are discharged at street level. However, there are other criteria that must be met to do this – for example, the water heater’s output has to be below a certain kilowattage, the CO<sub>2</sub> levels must be 1% or less, and plumbing must not cause a nuisance. The system would also need to be controlled so that, if it fails, the water heater would switch off safely.

Another issue is that condensate forms within a condensing water heater and secondary flue ways, so connection to a suitable drain is required to dispose of it. A sump pump can be used to carry condensate from a basement or sub-basement water heater to a drain.

It is also extremely important to specify a water heater that can handle higher levels of water pressure, if it is supplying hot water to upper floors from the basement. In a new development – where the water heater is

normally located near the top of the building – the unit is subjected to far less water pressure because gravity increases the pressure further down.

The opposite happens when the hot water is generated in the basement. The static pressure at the water heater needs to be sufficient to lift the design water flowrate to the highest floor. This is particularly important in applications such as hotels, where enough pressure must be delivered to all floors so that appliances such as showers can operate effectively and meet guests’ expectations.

**“A fan dilution system can be employed to dilute the flue products to a safe level before they are discharged at street level”**

It is crucial that a water heater and its components – in particular the tank or cylinder – can withstand the pressure required for safety reasons. In unvented systems, safety measures limit the pressure and temperature of the cylinder because, when water is under pressure, its boiling point changes. Usually, it’s around 97-100°C, but this increases under high pressure. If the thermostat fails to detect that the water temperature inside the tank is too high, the tank could rupture. Water that was under higher pressure inside the tank would flash to steam on contact with normal atmospheric pressure outside the unit, which could lead to an explosion in the plantroom.

If it is not feasible to install new water heaters in the original plantroom, they will have to be relocated to the upper floors of a building. It is unlikely that the prime areas sacrificed for this purpose will be as constrained for space as the basement, so specifiers must bear in mind the amount of room available when selecting a water heater.

The challenges discussed above are more commonly seen in large cities; with period, multi-storey structures in built-up areas, flues need to be located considerably. Issues with water pressures would also apply, and specifiers have to balance technical requirements – plus local and national regulations – with commercial feasibility.

Despite the complexities of retrofitting modern heating equipment into a period construction, however, we have seen many successful installations. In the interests of improving energy efficiency while preserving historic architecture, the challenge is worth it. **CJ**

■ **DAVID RIDGWAY** is product application manager at Andrews Water Heaters



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# Defending the design

To protect design specifications, engineers should make the most of manufacturers' specialist knowledge, says Remeha's Ryan Kirkwood

Improving the efficiency of heating systems in existing buildings is a major challenge for the building services industry. On projects where the equipment can help define a solution, manufacturers have a valuable part to play in the design.

On schemes requiring a change of technology or fuel source, for example, a site visit by manufacturers to survey the existing boiler plant will help identify potential challenges at an early stage.

With law changes aimed at reducing energy use – such as Part L2 (Section 6) of Building Regulations – designers must introduce low carbon components into heating system designs. Specifying technologies such as combined heat and power (CHP) and gas absorption heat pumps, in conjunction with condensing boilers, is becoming a necessity. Early consultation with manufacturers could save time and fees in creating a design that maximises efficiency.

It could also prevent pitfalls from value engineering. For example, if one heat interface unit model performs better than another in lower temperature circuits, switching the specified product on a 70°C/40°C heat network design could adversely affect system performance. Involving manufacturers from the outset could help define and defend the optimal heat generation design.

## How regulations affect design

Regulations influencing designs include the tighter energy efficiency requirements for space heating, introduced under the Ecodesign for Energy-Related Products (ErP) Regulations. This rules out fitting non-condensing boilers below 400kW into new-build and replacement projects.

In January 2018, like-for-like replacement of non-condensing, pressure-jet-style oil, gas and dual-fuel systems ended. From 26 September 2018, mandatory nitrogen oxide (NO<sub>x</sub>) requirements come into force, with maximum emissions of 56mg/kWh for gas and liquefied petroleum gas (LPG) boilers, and 120mg/kWh for oil-fired boilers.

Previously, when refurbishing buildings such as schools, a 10-section, pressure-jet boiler with a gas, two-stage burner would be replaced by a 10-section pressure-jet boiler with a modulating burner. This would allow the flue and pipework to remain more or less the same, with a small increase in efficiency because of the modulating burner. Under ErP, the same scenario will need a condensing equivalent – generally a pre-mix burner – that requires new flue arrangements and pipework modifications.



**“Bolting on technology to a dated design to meet energy targets is not acceptable”**

In situations such as these, designers will need to understand the effects of adding new products and technologies into their designs. For instance, one condensing boiler may, on paper, deliver the same efficiencies as another, but the flue tolerance may differ – and value-engineering out the specified boiler could result in costly changes to design.

An all-too common issue is condensing boilers being installed in such a way that they can't fully condense and achieve the higher efficiencies. Simply bolting on a piece of technology to a dated design to meet new energy targets is not acceptable.

When switching from non-condensing to condensing boiler technology, it's essential to consider fundamental factors such as radiator circuit temperatures and weather-compensation control. System performance can only be achieved if the control philosophy is laid out before commissioning.

Communication with manufacturers is important when it comes to controlling hybrid systems. Each component on a system using heat pumps, CHP and boilers has unique temperature limitations. However, the tendency can be to design or operate the system as if it were a boiler, on the return temperature. Manufacturers can offer advice on optimising the performance of individual components.

With their expert technical knowledge, manufacturers can support engineers and give design teams the confidence to defend the integrity of their design.

## ACHIEVING GOOD DESIGN PRACTICE

- **Time:** Factor in sufficient planning time and allow your chosen manufacturer to support you with your design
- **Effective control:** Ensure onboard controls are not overlapping with the overall control strategy of the building. Make sure they harmonise with the existing or new controls scheme, and are well integrated
- **Keep it simple:** Avoid over-complicating designs to overcome downfalls in equipment attributes
- **Learn from experience:** Ask manufacturers for exemplar designs that illustrate overall design philosophies
- **Check and double-check:** Ask manufacturers to look at schedules, specification and related drawings before sending out the job. A fresh pair of eyes could spot something that may lead to ambiguous pricing in the future. This allows manufacturers to understand the outcome of the design decisions and to prepare for technical questions from the tendering contractor

**RYAN KIRKWOOD**  
is Remeha's area sales manager for Scotland and a former consultant engineer

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# Tackling NO<sub>x</sub>

The next phase of the Energy Related Products Directive has been introduced to combat boiler NO<sub>x</sub> emissions. Ideal Commercial Boilers product manager Chris Caton urges the industry to prepare for change

The Energy Related Products (ErP) Directive has been implemented in phases since 26 September 2015, with the last phase coming into force on 1 January 2018. This applies to the manufacture of non-condensing pressure-jet boiler shells or burners less than 400kW.

The regulation is part of the EU's commitment to reaching its 2020 goals of reducing greenhouse gas emissions by 20% and overall energy consumption by the same amount. It is important for heating engineers, facilities managers, specifiers, contractors and building engineers alike – and everyone should be prepared for the change.

The ErP arrived on the back of a series of measures designed to reverse the negative environmental impact of a range of products, from boilers to storage heaters and beyond. (See panel 'ErP key points'). The latest change comes amid media coverage of emissions, with the London Environment Strategy consultation and Clean Air Zone Framework announced earlier this year. Discussion has largely focused on vehicles, but buildings and their heating systems emit significant levels of NO<sub>x</sub>. For example, 33% of NO<sub>x</sub> emissions in central London are related to non-domestic gas combustion, according to the City of London Corporation. This, and the fact that poor air exposes us all to health risks linked to respiratory and pulmonary disease, is another reason to tighten regulation.

In line with the new regulations, Ideal Commercial's standard efficiency pressure-jet oil and blown gas boilers



**"33% of NO<sub>x</sub> emissions in central London are from non-domestic gas combustion"**

with outputs of less than 400kW have been discontinued. These include the Falcon and Harrier ranges, and one model from each of the Viceroy and Vanguard L ranges. Customers can still buy products already on the market, and order replacement parts.

Although the regulation only applies to the manufacture of products and installation – rather than repair – it makes sense to think about upgrading to a new, more efficient boiler. With the average commercial boiler's lifespan being 10-15 years, a switch could cut costs, as well as emissions.

After all, newer condensing boilers achieve energy efficiencies of more than 90%, benefiting from new technologies that pressure jet-oil and blown gas boilers cannot match.

The ErP regulation will help us all in the long run, thanks to improved air quality and efficiency improvements resulting in lower energy costs.

If boilers – especially as part of an older heating system – are already showing signs of age, it may make sense to consider a full service and repair as early as possible, to avoid costlier parts replacement in the long term.

In the main, the switch should be seamless, but sizing the heating load of a building is vital to ensure the correct size of boiler, resulting in better energy performance and a more efficient way of heating buildings.

While a new boiler may boast top-class energy efficiency credentials, other factors within a heating system could affect efficiency. Much more can be done to drive down costs and decrease fuel consumption. For example, installing a new boiler into an old system containing debris and dirt – or dirty water – will affect its running and could lead to breakdowns.

System separation could be a viable consideration – introducing new boilers to an existing system via a plate heat exchanger, physically separating the primary circuit, and transferring heat through the system without each coming into direct contact.

To ensure good water quality, use relevant water treatment in line with Industrial and Commercial Energy Association (ICOM) guidelines. (See 'Keeping it clean', *CIBSE Journal*, May 2017). Also, make sure end users are trained in using building controls, that bill and usage patterns are monitored, and that regular, routine maintenance is carried out to comply with warranties.

## ERP KEY POINTS

- The ErP dictates that only energy efficient, low NO<sub>x</sub> heating products are manufactured, specified and installed
- It applies only to new equipment being sold or installed
- When introduced in 2015, it set mandatory efficiency requirements for all boilers up to and including 400kW – meaning only condensing boilers would fit the bill
- From 1 January 2018, standard efficiency pressure-jet oil and blown gas boiler bodies cannot be manufactured for like-for-like installations. Existing stock on the market can still be sold and installed
- The ErP introduces minimum energy performance standards, nitrogen oxide and noise emissions limits, and the A-G energy efficiency classification for products equal to, or less than, 70kW
- From 26 September 2018, ErP enforces maximum NO<sub>x</sub> emissions of 56mg/kWh for gas-fuelled boilers and 120mg/kWh for LPG and oil-fuelled boilers

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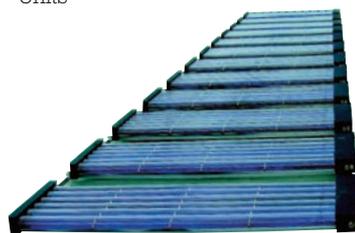
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# Rising prices, but stay cool

The price of refrigerants has risen significantly in the past year, but this is all part of a bigger focus on reducing the impact of buildings on the environment. Mitsubishi Electric's Donald Daw explores the issues

If you are involved in air conditioning or refrigeration in any way, you will have noticed that the price of various refrigerants has been rising over the past year. The cost of R410A, in particular, has gone up by around 30% through consecutive months.

The reason for this is the 2014 F-Gas regulation, introduced with the key objective of reducing the global warming potential of refrigerants used in HVAC and refrigeration equipment.

For air conditioning, the refrigerant of choice for many years has been R410A, but this has a high global warming potential (GWP) of 2,088 (baseline is CO<sub>2</sub> with a GWP of 1).

In January, we saw the first significant reduction in the available quotas for refrigerants, and there will be another in three years' time. While regulations can often be slow to bring about change, I expect the F-Gas regulation will facilitate rapid transformation in the air conditioning and refrigeration markets.

By limiting the availability of refrigerants, using the CO<sub>2</sub> quota-based system, the regulation forces evolution. If the industry wishes to grow – or even sustain the levels of business we enjoy today – it will rapidly need to change the refrigerant it uses in new products.

This makes the regulation highly effective and has resulted in manufacturers pushing development of new equipment with different systems and refrigerants. It is also the primary reason the cost of R410A is rising so dramatically – less supply equals higher prices.

Existing systems need to continue in operation, however, so the regulation allocated available quota to 'field service' ahead of manufacturing new products.

Servicing equipment with higher GWP refrigerants will become more expensive – although, if it is well installed and maintained, it should not be leaking anyway. Refrigerant should not be considered a consumable in a sealed system.

With the price of refrigerants going up, and limited availability, we may begin to see a growing market in recycled refrigerant – this was not cost-effective when virgin refrigerant was much cheaper.

Manufacturers have been through changes in refrigerants before, and I can say with certainty that the market will adapt and carry on delivering the products and solutions that we need for our modern, built environment.



**"With limited availability, we may see a growing market in recycled refrigerant"**

With every change, the new products that have come to market have had better performance than those they replaced. I don't see why it will be any different this time. There has always been a bit of over-dramatisation when it comes to refrigerant change in our industry – and then things return to a new normal.

We are already seeing R32 direct-expansion systems being launched as the next-generation replacement for R410A. R32 has a GWP of 675, one-third that of R410A; these systems are more efficient than the ones they replace and offer improved functionality.

Depending on the market sector and type of products, we will also see a greater variety of refrigerants in general use; HFO, CO<sub>2</sub> and hydrocarbons are all likely to be a solution in some product sectors.

Alternative technologies that look to reduce the volume of refrigerant used in a system will enter the market. Our hybrid variable refrigerant flow (VRF) system, for example, uses water as the distribution fluid to the indoor units.

For me, though, the debate around refrigerants is merely part of a larger narrative about energy use and sustainability that is grabbing attention now.

All buildings in the UK require heating – and occasionally cooling – and this consumes energy. We need to ensure that these properties are built, or made, as thermally efficient as possible, so we can minimise the amount of equipment and energy needed to keep them comfortable. Installing smaller plant for lower loads is a great way to use less refrigerant and help with the challenge of F-Gas.

This is essentially the thrust of the Minimum Energy Efficiency Standards (MEES), which come into effect on 1 April, and which will penalise commercial landlords that haven't improved the efficiency of their buildings.

It is also the thinking behind the Energy Related Products (ErP) Directive, which requires a clear, visible, energy label on each piece of energy-consuming equipment, be it a fridge, TV or air conditioning unit.

All of this points to a future where the whole life-cycle of a building and its equipment is clearly mapped out from day one, with every element visible – from sustainable manufacturing and effective control and maintenance regimes throughout operational life, to a clear and ethical disposal and recycling regime.

**■ DONALD DAW**  
is the commercial  
director at  
Mitsubishi Electric

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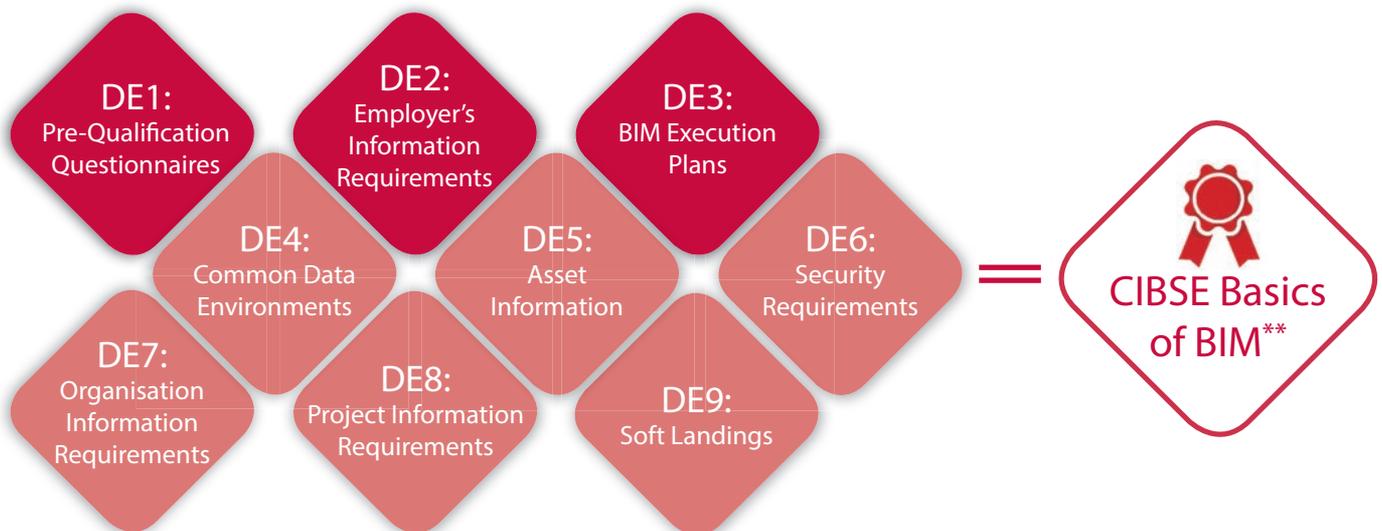
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# **CIBSE** **JOURNAL**

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**SALARY SURVEY  
REVEALS RISING PAY  
BOOSTING BUSINESS  
WITH APPRENTICES**

## **ROUTES TO SUCCESS**

**Building services engineers describe  
alternative ways into the profession**

“Seeing projects coming to completion and being able to say that I have had input gives me the biggest buzz” – Sofia Tolia

Building services is not limited to HVAC engineering – the sector incorporates many essential specialisms. **David Blackman** speaks to four engineers who followed roads less travelled to get into the profession

# Different route, same destination

Once upon a time, building services meant heating, ventilation and air conditioning (HVAC) engineering – but, now, the routes into the profession are much more varied.

The ever-increasing focus on sustainability, for example, has put the environmental performance of buildings under the microscope. This, in turn, has spawned a whole new sub-set of disciplines within the sector, including energy assessors and environmental engineers.

Other burgeoning specialisms in building services include: digital engineering; building data analysis; modelling; façade engineering; public health; lighting; and lifts engineering.

These roles are offering new routes of entry into the discipline and paths towards chartered status. *CIBSE Journal* talks to young engineers who are carving out careers in some of the more niche corners of the building services world. **CJ**

ESSENTIAL SERVICES

Components that make buildings habitable

- Air conditioning and refrigeration
- Communications, telephones and IT networks
- Control systems
- Energy supply - gas, electricity and renewable sources
- Escalators and lifts
- Façade engineering
- Fire detection and protection
- Harnessing renewable energy, such as solar power
- Heating and ventilating
- Lighting - natural and artificial
- Public health engineering
- Security and alarm systems

The variety of jobs within building services

- Air conditioning engineer
- Business manager or proprietor
- Building physics engineer
- Carbon emissions specialist
- Computer-aided design technician
- Commissioning engineer
- Consulting engineer
- Contract or project engineer
- Design engineer
- Domestic heating engineer
- Domestic plumber
- Ductwork installer
- Educator and trainer
- Electrotechnical panel builder
- Electrical repair and rewinder
- Energy inspector/adviser
- Environmental engineer
- Estimator
- Façade engineer
- Facilities manager
- Fitter/welder
- Gas fitter
- Heating and ventilating engineer
- Highway electrical systems installer
- Industrial and commercial plumber
- Installation electrician
- Instrumentation installer/engineer
- Lighting expert
- Maintenance electrician
- Project engineer
- Public health engineer
- Quantity surveyor
- Refrigeration engineer
- Satellite systems engineer
- Service and maintenance engineer
- Sheet metal weathering specialist
- Site supervisor

SOFIA TOLIA, lighting design manager, Ringway Jacobs



Sofia Tolia says lighting is in her blood. The 29-year-old was born, and grew up, in Greece, where her father ran a lighting supply company. However, she was always more interested in design than sales.

After taking a diploma in chemical engineering at Athens University, Tolia came to the UK to study for an MSc in light and lighting at University College London.

After gaining her degree, she worked as a lighting engineer for Aecom, staying for three years before being appointed to her current role earlier this year.

Tolia says she loves working with other people and managing a team; being a lighting engineer means she gets involved throughout the design and construction processes.

Working on exterior lighting projects also ensures involvement in projects at an early stage, identifying the lighting solutions that will work best, structurally, and be easiest to maintain.

'It's not like interior lighting, where it's mainly design and the engineering comes at the end,' she says.

Tolia adds: 'Seeing projects coming to a completion and being able to say that I have had input gives me the biggest buzz.'





LEONORA LANG, senior engineer, Arup



If things had gone to her original plan, Leonora Lang would now be working on the US space science programme. She is still reaching for the skies, however, in Arup's vertical transport team, which deals with lifts and escalators.

After taking a BSc in physics, Lang graduated with a MSc in space science, before completing a PhD in mechanical engineering. The 37-year old admits that,

by this point, she was hard to pigeonhole, career-wise. 'I'd done a range of subjects, so people didn't know where to put me.'

However, Arup gave her a break in 2005, offering her a chance to work in its vertical transportation team.

Since then, how people use elevators and lifts has become more sophisticated. Three of the five major manufacturers now produce lifts that can be called from a mobile phone, rather than by pushing a button on the wall.

Lang has no regrets about entering the building services discipline; the sheer variety of projects offers her opportunities to work with a wide range of professionals. She particularly loves getting involved at the beginning of the construction process, when designs are being worked up.

'With the architects, we work out the most elegant solution possible to give the performance expected of the lifts and escalators.'

"BIM is now an integral part of the design process. It's the way the industry is going" – Alison Ryan



LEAH JARVIS, engineering technician, Hoare Lea



Friday used to be the longest day for Leah Jarvis. When studying for her building services Higher National Certificate (HNC), she would leave her home in Plymouth by 5.30am to ensure she arrived at Bath College – where she went on day release from work – in time for lectures.

Bath was the nearest college to offer a building services course. At the end of the day, she would often hurry back to Devon in

time to perform in a band, in which she played bass.

Two years of getting up early paid off in October 2014, when she passed her Level 4 BTEC HNC with a merit.

Jarvis has been with Hoare Lea since she left school at 17 to take up an administration job at the company's Plymouth office. But she knew she didn't want to be in that line of work forever.

She persuaded her manager to give her a job as a Breeam assessor, which gave her a working knowledge of M&E and building services. Jarvis then worked on heating, but – keen to develop a specialism – she took a job within Hoare Lea in public health engineering, which involves fitting buildings' drainage systems.

Public health offers a steady stream of work – 'Every building needs a drainage system' – and, adds Jarvis, it is more complex than many of her counterparts in building services believe. 'Mechanical engineers think a drainage system is a number of pipes that just need to be connected up, but it can be complicated.'

When designing a drainage system, she says it is necessary to take into account the building structure and gradients. 'The pipework needs to fall correctly to be self-cleansing and it needs to be adequately vented. If a system is not vented correctly, it can have an impact on the building's occupants.'

Fumes and smells are just two of the issues that can arise from a badly designed drainage system, says Jarvis. 'If the pipework is left unvented, it can cause blockages – and people won't want last night's tea coming back up the toilet,' she says.

ALISON RYAN, BIM lead, DSSR



Building information modelling (BIM) is a good way of sparking youngsters' interest in building services, DSSR found out when it carried out a demonstration at a local school's careers fair.

The consulting engineering company wanted to promote the building services industry to young people and show how the building design process is developing from an architectural, structural and

M&E perspectives.

Alison Ryan, who is BIM lead at DSSR, is developing its policies in relation to BIM, and describes how the firm brought the discipline alive to pupils.

'Their eyes light up because the visuals are quite impressive,' says Ryan, who is also a regional partner at the company.

Ryan has been with DSSR for more than 16 years since completing a physics degree at Leeds University in 2001. She has since undertaken a Master's in building services engineering management, via distance learning, at Brunel, and has been involved with BIM for five years.

Now she is chair of the IHEEM Professional Development Committee, and a member of the industry-wide BIM4Health and the CIBSE Digital Steering Group.

During this time, she says, BIM has become an increasingly common part of the construction process, helping to reduce clashes as projects get passed from one part of the design team to another.

The government set out its Construction Strategy over a four-year period from May 2011, which requires fully collaborative 3D BIM – with all project and asset information, documentation and data being electronic – from 2016 onwards. 'It's now an integral part of the design process,' Ryan says. Private clients are now asking to use it too, she adds: 'It's the way the industry is going.'



TB+A apprentices are currently working on the new London headquarters for the Royal College of Pathologists

# Blazing a trail

Each year, Troup Bywaters + Anders takes on up to 10 apprentices, who can learn without amassing student debts. **David Blackman** finds out why it's also good business sense for the firm

It used to be *de rigueur* in building services to rise from the shop floor to the upper echelons of the profession. Neil Weller, partner at Troup Bywaters + Anders (TB+A) is a product of this career path.

He joined Hayden Young as an apprentice at the age of 16, before moving to TB+A seven years later. He has stayed there ever since. 'I had an offer of an apprenticeship and felt it was the best way for me. It was the best decision I ever made,' he says.

As part of the apprenticeship, Weller did a degree in building services engineering, which his employer paid for. 'Most of us trained that way. We learned the craft from an older engineer, who imparted their knowledge and skills.'

Nearly two-thirds (60%) of TB+A's current partners started their career as apprentices with the business. 'We've always trained our own people,' Weller says. 'Most people in the firm, and partners, have been here since we were kids.'

However, on-the-job training has fallen out of vogue for many businesses since Weller cut his engineering teeth in the 1970s. 'Apprenticeships lost their way because a lot of kids were studying full-time and not choosing engineering,' he says.

That picture has changed, though, since

the introduction of student fees, which have led many to revisit the assumption that university is the best way to forge a career.

'The cost is prohibitive,' says Weller. 'So many kids are saying their families can't afford it, but they are looking for a route that will give them an opportunity. People were talking about a lost generation and course fees going up - we knew that apprenticeships were a good way to help youngsters out.'

Five years ago, TB+A launched its apprenticeship scheme and since then has taken on eight to 10 young people a year. As a first step, the business supports them through an advanced apprenticeship, which is a Level 3 BTEC qualification, completed by attending college one day a week. At the same time, apprentices take a National Vocational Qualification (NVQ). Once they have passed these, the apprentices can take an engineering degree - or a Higher National Diploma (HND) if their maths isn't sufficiently good for university study.

'As long as they work hard and do well at college, we will push them as far as they want to go,' says Weller. He believes it is worth putting time and effort into apprentices because they are more loyal than those who join the firm with more advanced qualifications. 'The apprenticeship retention rate is 92% - which is extraordinary.'

Thanks to the scheme, 40 of TB+A's 200 staff have passed through the apprenticeship scheme or are currently on it. They include two who have graduated with engineering degrees.

'The quality of people we are bringing on is quite exceptional,' says Weller - and the firm's work on promoting apprenticeships has won recognition beyond the building services world.



TB+A partner Neil Weller



» TB+A was named Apprentice Employer of the Year at the annual Investors in People (IIP) and WISE awards in 2017. IIP also awarded the company its Platinum accreditation – an accolade held by only 1% of the organisations it works with. Meanwhile, head of HR Claire Oliver’s work on developing and rolling out Trailblazer apprenticeships in building services secured her the HR Star of the Year award at the 2017 Construction Investing in Talent Awards, where TB+A was also named Best Place to Work (Consultant).

While the firm’s work on apprenticeships has won plaudits, Weller is keen to stress that it also makes sound business sense.

‘You are not trying to retrain someone into your culture and values, which can be quite time-consuming and difficult with people who are set in their ways,’ he says.

‘With a youngster at 16, you can instill your own ethos and brand because they grow up with it. You are moulding and mentoring them.’

Weller believes investing in the workforce will also help to ensure the company’s longevity: ‘It works really well for taking the firm forward in the years to come.’ Apprenticeships also promote the wider health of building services, he adds: ‘It’s a really successful way of getting people into the industry.’

One of the challenges for those running apprenticeship programmes is finding a nearby college that can offer courses.

Weller acknowledges that it can be a ‘struggle’ to achieve the critical mass of students needed to sustain courses. But he says the launch of the Trailblazer apprenticeship scheme for building services engineering will give institutions more solid incentives to offer tailored courses.

‘It is easier now, with Trailblazer, for colleges and universities to make a business case to provide courses,’ he says. ‘In this day and age, we should be much smarter in terms of how we teach people. It’s beyond me why we can’t use video conferencing to deliver one university [course] throughout the whole country.’

These kind of imaginative solutions will become increasingly important, Weller believes, based on the feedback he has had from education providers.

The increase in university course tuition fees means fewer youngsters are likely to study building services engineering full time, further restricting the long-term supply of graduate candidates.

‘Without the apprentice route, the number of graduates would be reducing anyway: it’s not the norm any more.’ **CJ**

TB+A APPRENTICES



Megan Whitbread



Micah Ukwunna

Megan Whitbread was ‘really interested’ in engineering, thanks in part to growing up with a father who worked in lighting and sound.

However, her plans to study engineering at GCSE level were thwarted ‘because there were only two girls interested in engineering at my all-girls school.’

She did do engineering at AS level and it was while doing a science project at a local building services company that whet her appetite for the industry. ‘I did a report on energy costs of the school and how it could be improved.’

After this experience, Whitbread decided to leave school at the age of 17 to take up an apprenticeship. ‘I felt like I was wasting time sitting around school in a classroom,’ she said. ‘It felt like the best route – and I am going to university, but not getting myself in debt.’

She consulted the government’s apprenticeship website, and spotted that TB+A was offering traineeships, so applied to the company. Having completed her Level 3 BTEC qualification at South Thames College last June, the 19-year old is now in the third year of her apprenticeship and enrolled on a degree course at South Bank University, where she will spend a day a week.

Alongside fellow apprentice Chloe Mansford, Whitbread was a finalist in the ‘one to watch’ category at the Women in Science and Engineering (WISE) Awards, recognising the work and commitment of young women as advocates of STEM.

Another TB+A apprentice, Micah Ukwunna, admits that getting a paycheck at the end of the month is a big motivation. The 19-year-old left sixth form after two months. ‘It wasn’t really for me, so I thought I would look for an apprenticeship instead,’ he said.

Barely a month after seeing that TB+A offered apprenticeships, he had landed a place with the company. ‘I always wanted to do something in engineering, and felt I could handle myself in maths and physics.’

Ukwunna has now been with the firm for two years, and is in the health team, working on hospital projects such as Barts.

Having mastered the basics of computer-aided design (CAD), he is now learning the mechanical principles of heating and cooling, and is in the final year of the Level 3 BTEC course in building services.

‘I’m working, learning, and getting practical experience straight away, rather than just going to school.’

“Nearly two-thirds (60%) of TB+A’s current partners started their career as apprentices with the business”



TB+A – as part of the Skanska team – is the engineer on the Papworth Hospital project

# Still on a high



Building services salaries have continued to rise above inflation. **David Blackman** finds out what it takes to attract – and retain – staff in a market driven by higher wages

**B**ritain has effectively had a pay cut in the past year, as average salary increases have failed to keep pace with rising inflation. However, building services engineers have bucked the trend, according to the results of a new, exclusive salary survey by recruitment consultants Hays.

Salaries for roles in building services rose by an average of 3.9%, up on the 3.5% increase seen last year, and easily ahead of inflation.

This means building services engineers are doing better than their colleagues across the wider construction and property sector, who recorded an average salary increase of 2.7%. They also comfortably outperformed the average across all professions, which was just 1.8%.

Nearly two-thirds (63%) of building services employers have raised salaries over the past 12 months, according to Hays. The good news for building services professionals is that more than half (56%) intend raising salaries again over the next 12 months, with one-tenth expecting this increase to be 5% or more.

Nearly half (48%) of building services professionals said they had received >>

The salary data has been compiled using information gathered during 2017 from Hays offices across the UK. It is based on job listings, job offers and candidate registrations. The recruiting trends are based on the survey findings of almost 17,500 employers and employees.

## Contractors: Directors

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£61,000	£60,000	£70,000
East of England	£57,500	£50,000	£72,500
London	£95,000	£70,000	£120,000
North East England	£54,000	£48,000	£60,000
North West England	£60,000	£55,000	£70,000
Northern Ireland	£67,000	£65,000	£85,000
Scotland	£55,000	£50,000	£60,000
South East England	£75,000	£73,000	£88,000
South West England	£60,000	£55,000	£70,000
Wales	£55,000	£52,000	£60,000
West Midlands	£62,500	£60,000	£80,000
Yorkshire and the Humber	£58,000	£55,000	£60,000
National average	£63,333	£57,750	£74,625

% increase year on year: 4.1%

“We’ve outperformed inflation for all salaries over seven or eight years, which has probably helped us hold on to people” – Tomas Neeson

» a pay increase this year, compared with 41% last year. The biggest increases have been for contracting roles, such as contract quantity surveyors, project managers and project engineers.

Richard Gelder, director at Hays Building Services, says companies are having to pay ‘above market’ rates to attract good people.

However, only 40% of building services professionals told Hays they were currently satisfied with their salary.

Two thirds (63%) said they would consider moving jobs within the next year, and dissatisfaction with salary levels is



**Contractors: CAD technician**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£28,500	£25,000	£30,000
East of England	£24,500	£22,000	£26,500
London	£41,500	£30,000	£50,000
North East England	£26,000	£22,000	£26,500
North West England	£29,000	£25,000	£30,000
Northern Ireland	£28,500	£24,000	£38,000
Scotland	£23,000	£22,000	£25,000
South East England	£35,000	£33,000	£40,000
South West England	£30,500	£25,000	£33,000
Wales	£29,000	£24,000	£34,000
West Midlands	£28,500	£22,000	£35,000
Yorkshire and the Humber	£25,000	£21,000	£26,500
National average	£29,083	£24,583	£32,875
% increase year on year: 3.7%			

**Contractors: Contract quantity surveyor**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£44,500	£40,000	£55,000
East of England	£42,000	£33,000	£51,500
London	£58,500	£45,000	£75,000
North East England	£40,500	£35,000	£42,000
North West England	£39,500	£35,000	£40,000
Northern Ireland	£40,000	£30,000	£42,000
Scotland	£42,000	£35,000	£45,000
South East England	£60,000	£60,000	£75,000
South West England	£46,000	£45,000	£60,000
Wales	£43,000	£34,000	£44,000
West Midlands	£43,000	£40,000	£50,000
Yorkshire and the Humber	£37,000	£30,000	£40,000
National average	£44,667	£38,500	£51,625
% increase year on year: 6.8%			

**Contractors: Estimator**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£41,250	£40,000	£50,000
East of England	£43,500	£35,000	£55,000
London	£56,000	£45,000	£60,000
North East England	£36,000	£30,000	£40,000
North West England	£41,000	£38,000	£45,000
Northern Ireland	£35,000	£30,000	£40,000
Scotland	£39,000	£35,000	£40,000
South East England	£59,000	£55,000	£70,000
South West England	£41,000	£35,000	£45,000
Wales	£38,500	£30,000	£40,000
West Midlands	£41,500	£30,000	£45,000
Yorkshire and the Humber	£34,500	£25,000	£35,000
National average	£42,188	£35,667	£47,083
% increase year on year: 3.8%			

**Contractors: Project engineer**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£37,000	£35,000	£42,000
East of England	£38,500	£32,000	£47,500
London	£49,000	£40,000	£60,000
North East England	£33,500	£28,000	£36,000
North West England	£39,000	£35,000	£40,000
Northern Ireland	£34,000	£28,000	£35,000
Scotland	£38,500	£35,000	£40,000
South East England	£42,500	£40,000	£50,000
South West England	£37,000	£35,000	£40,000
Wales	£35,000	£28,000	£36,000
West Midlands	£38,000	£30,000	£45,000
Yorkshire and the Humber	£34,000	£30,000	£40,000
National average	£38,000	£33,000	£42,625
% increase year on year: 5.3%			

**Contractors: Project manager**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£48,000	£45,000	£50,000
East of England	£47,000	£40,000	£57,000
London	£68,000	£50,000	£75,000
North East England	£44,000	£40,000	£50,000
North West England	£46,500	£40,000	£55,000
Northern Ireland	£37,000	£35,000	£40,000
Scotland	£43,500	£38,000	£50,000
South East England	£65,000	£58,000	£68,000
South West England	£46,000	£40,000	£55,000
Wales	£42,500	£37,000	£45,000
West Midlands	£46,000	£40,000	£55,000
Yorkshire and the Humber	£47,000	£40,000	£57,000
National average	£48,375	£41,917	£54,750
% increase year on year: 5.5%			

**Contractors: Senior contracts manager**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£51,000	£50,000	£60,000
East of England	£53,000	£45,000	£62,000
London	£65,000	£50,000	£75,000
North East England	£42,000	£30,000	£45,000
North West England	£44,500	£38,000	£50,000
Northern Ireland	£47,000	£45,000	£55,000
Scotland	£45,000	£38,000	£50,000
South East England	£65,000	£58,000	£68,000
South West England	£50,000	£45,000	£60,000
Wales	£47,500	£40,000	£50,000
West Midlands	£50,000	£45,000	£65,000
Yorkshire and the Humber	£38,500	£34,000	£43,500
National average	£49,875	£43,167	£56,958
% increase year on year: 5.1%			

the main factor (40%) driving thoughts of a potential job move.

Further evidence of simmering pay tension is the survey's finding that nearly the same proportion of employers (39%) named unrealistic salary expectations as the second-biggest recruitment challenge they faced.

Doug Kerr, managing director at Elementa, says it is increasingly difficult to hold on to good-quality staff – although this partly stems from the firm's growing profile, too, after winning the CIBSE Building Performance Award for best consultant.

'A lot of people's personal profiles are getting higher. We've got to work harder to keep the sharks from circling the door, which is really a problem of success.'

Tomas Neeson, managing partner at Cundall, says a string of inflation-busting salary increases has insulated the company against a rapid turnover of staff. 'We have outperformed inflation for all salaries over seven or eight years, which has probably helped us hold on to people.'

Another plus point for Cundall, Neeson says, is the firm's partnership structure. 'We seem to be able to attract people at the highest level because we are a partnership: the higher up we go, the easier it gets.'

Salary levels have been buoyed by a strong market for building services, which Hays suggests will continue in 2018. All the

building services employers surveyed said they expected business activity levels to increase – or, at least, remain the same – over the next 12 months.

This is an even higher figure than last year's post-Brexit poll, when 97% of firms reported confidence about their business growth prospects.

'The sector, as a whole, is in a pretty good place,' says Gelder. 'It's been a super-hot market, so any cooling will leave it as a pretty good market.'

Neeson plans to increase Cundall's headcount this year, albeit at a slower pace than in 2017, when its overall staff numbers swelled by 100, to more than 800.

This positive picture of hiring intentions is reflected across the building services field: more than three-quarters of employers plan to recruit this year.

With hiring holding up, finding people with the right skills remains a headache for building services employers. 'Skills



32%

Proportion of employees for whom job security is most important when considering a move

**Consultants: Associate**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£57,500	£55,000	£65,000
East of England	£52,000	£50,000	£65,000
London	£68,000	£60,000	£75,000
North East England	£43,000	£38,000	£45,000
North West England	£56,500	£50,000	£60,000
Northern Ireland	£51,500	£45,000	£55,000
Scotland	£52,500	£50,000	£60,000
South East England	£60,000	£55,000	£63,000
South West England	£56,000	£50,000	£60,000
Wales	£51,500	£40,000	£52,500
West Midlands	£55,000	£50,000	£60,000
Yorkshire and the Humber	£48,000	£42,000	£49,000
National average	£54,292	£48,750	£59,125
% increase year on year: 3.2%			

**Consultants: CAD technician**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£28,250	£25,000	£30,000
East of England	£30,000	£25,000	£37,000
London	£34,000	£30,000	£38,000
North East England	£24,500	£21,000	£25,000
North West England	£28,250	£25,000	£35,000
Northern Ireland	£20,500	£18,000	£25,000
Scotland	£26,000	£22,000	£30,000
South East England	£32,000	£31,000	£37,000
South West England	£29,000	£25,000	£35,000
Wales	£29,500	£23,000	£32,000
West Midlands	£27,250	£23,000	£35,000
Yorkshire and the Humber	£26,500	£22,000	£28,000
National average	£27,979	£24,167	£32,250
% increase year on year: 2.4%			

**Consultants: Director**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£63,000	£60,000	£70,000
East of England	£62,000	£50,000	£70,000
London	£90,000	£80,000	£100,000
North East England	£51,000	£42,000	£54,000
North West England	£66,500	£60,000	£70,000
Northern Ireland	£61,500	£50,000	£70,000
Scotland	£58,500	£55,000	£65,000
South East England	£70,000	£64,000	£74,000
South West England	£58,500	£55,000	£65,000
Wales	£55,000	£52,000	£57,500
West Midlands	£65,000	£60,000	£75,000
Yorkshire and the Humber	£52,000	£42,000	£55,000
National average	£62,750	£55,833	£68,792
% increase year on year: 2.7%			

**Consultants: Intermediate design engineer (M&E)**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£35,000	£30,000	£38,000
East of England	£38,500	£33,000	£50,000
London	£39,000	£32,000	£45,000
North East England	£30,500	£28,000	£32,000
North West England	£35,000	£25,000	£38,000
Northern Ireland	£27,000	£25,000	£32,000
Scotland	£35,500	£30,000	£40,000
South East England	£35,000	£34,000	£39,000
South West England	£38,000	£28,000	£40,000
Wales	£35,000	£28,000	£38,000
West Midlands	£33,000	£25,000	£37,000
Yorkshire and the Humber	£26,500	£22,000	£28,000
National average	£34,000	£28,333	£38,083
% increase year on year: 3.4%			

**Consultants: Junior design engineer (M&E)**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£26,500	£24,000	£28,000
East of England	£24,500	£20,000	£28,000
London	£29,000	£25,000	£32,000
North East England	£21,500	£18,000	£24,000
North West England	£26,000	£18,000	£27,000
Northern Ireland	£23,500	£21,000	£25,000
Scotland	£27,500	£25,000	£30,000
South East England	£28,500	£26,000	£32,000
South West England	£27,000	£20,000	£28,000
Wales	£25,500	£22,000	£28,000
West Midlands	£24,000	£18,000	£28,000
Yorkshire and the Humber	£21,500	£18,000	£24,000
National average	£25,417	£21,250	£27,833
% increase year on year: 2.3%			

**Consultants: Professional quantity surveyor**

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£46,000	£40,000	£50,000
East of England	£49,000	£40,000	£55,000
London	£65,000	£50,000	£75,000
North East England	£39,000	£35,000	£40,000
North West England	£43,500	£38,000	£45,000
Northern Ireland	£35,500	£30,000	£37,000
Scotland	£39,000	£38,000	£50,000
South East England	£64,500	£63,000	£73,000
South West England	£50,000	£45,000	£60,000
Wales	£42,500	£34,000	£45,000
West Midlands	£43,000	£32,000	£50,000
Yorkshire and the Humber	£41,500	£35,000	£45,000
National average	£46,542	£40,000	£52,083
% increase year on year: 3.2%			

shortages are not getting much worse, but they're not getting better,' says Gelder.

Nearly two-thirds (62%) of firms surveyed by Hays said a shortage of suitable applicants will be their main recruitment challenge this year. More than eight in 10 (83%) respondents said they had faced skills shortages this year, with a third describing the situation as 'extreme'.

This dearth of suitably qualified staff is resulting in wider business headaches for building services employers. More than two-thirds (68%) reported that skills shortages were having an impact on productivity; nearly a third (30%) said the lack of skilled staff was inhibiting growth; while 20% said it was affecting employee morale.

Elementa has responded to the tight labour market for building services professionals by being more selective about its recruitment, says Kerr: 'We hold out for what we want, rather than getting bums on seats.' Nigel Williams, director of building services at Atkins, agrees with this approach: 'We have a lot of organic growth coming through - going out and looking for 20 to 30 bodies in two weeks to deliver a major project is not happening at the moment.'

In addition, Elementa has increased investment in its graduate trainee scheme, says Kerr. 'It's a big commitment,' says Kerr, 'but, without it, we will suffer in the future.'

While organic growth plans and future work pipelines are strong, Gelder warns that this positive outlook is 'heavily tinged' by the uncertainty surrounding the impact of Brexit on the economy.

Tier one contractors' order books are 'pretty full' for 2018, but Kerr notes that



More than eight in 10 employers surveyed said they had faced skills shortages in 2017, with a third describing these as 'extreme'

they are generally uncertain about subsequent workflows. While continuing to plan for growth, he says Elementa will use 2018 to take stock. 'I suspect margins will be squeezed for many years. We want to use the time to be ready when we have more clarity about the market at the end of 2018.'

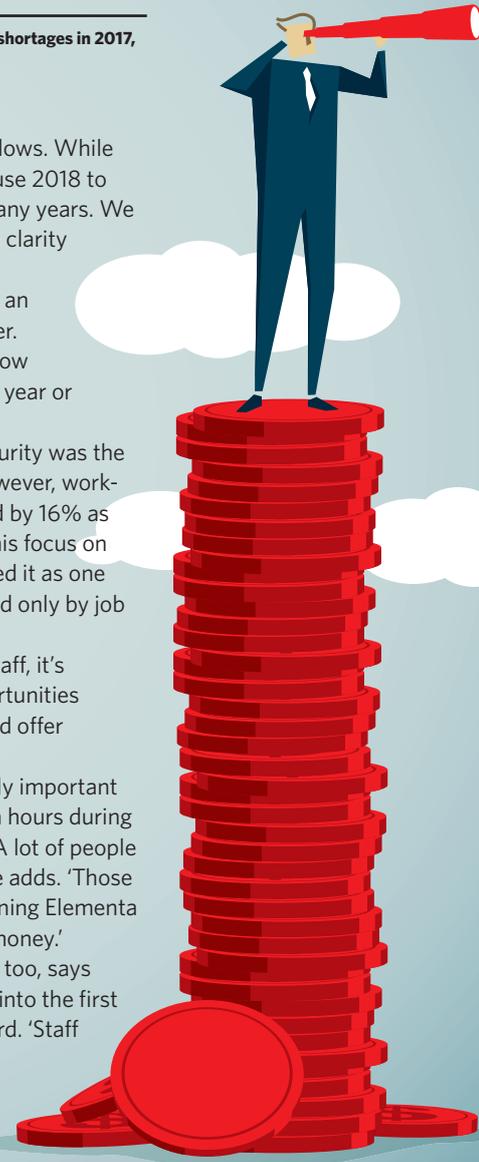
The uncertain economic environment has also had an impact on labour-market mobility, according to Gelder. 'We are fairly confident that there are fewer people now strongly considering a move, as against this time last year or two years ago,' he says.

A third of employees (32%) told Hays that job security was the most important factor when considering a move. However, work-life balance remains a strong consideration, identified by 16% as key when weighing up employment opportunities. This focus on work-life balance is mirrored by employers - 19% cited it as one of the main considerations for candidates, outstripped only by job security (22%).

Gelder says: 'For employers looking to retain key staff, it's advisable to communicate career development opportunities clearly, to ensure employees can progress quickly, and offer continued learning to improve job satisfaction.'

To recruit and retain staff, Kerr says it is increasingly important to offer flexibility, such as allowing staff to work extra hours during the week so they can get away at midday on Friday. 'A lot of people have young families, so we have to offer flexibility,' he adds. 'Those things can make the difference between someone joining Elementa and other very good companies - it's not just about money.'

Creating a good working environment is important too, says Neeson. Cundall's London office has recently moved into the first premises in Europe to meet the Well Building Standard. 'Staff turnover had dropped to nearly zero in that time, and absenteeism has really dropped,' he says. 'It is worth spending money on this stuff, because you actually make money on it.' □



Consultants: Revit/BIM technician

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£34,000	£30,000	£40,000
East of England	£32,000	£28,000	£38,000
London	£47,500	£40,000	£60,000
North East England	£34,000	£28,000	£35,000
North West England	£37,500	£30,000	£40,000
Northern Ireland	£25,500	£22,000	£28,000
Scotland	£31,500	£25,000	£38,000
South East England	£42,500	£40,000	£52,000
South West England	£38,000	£35,000	£45,000
Wales	£36,000	£30,000	£39,000
West Midlands	£33,000	£26,000	£40,000
Yorkshire and the Humber	£35,000	£28,000	£36,000
National average	£35,542	£30,167	£40,917
% increase year on year: 6.5%			

Consultants: Senior design engineer (M&E)

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£48,000	£40,000	£50,000
East of England	£46,000	£40,000	£55,000
London	£55,000	£50,000	£65,000
North East England	£44,000	£40,000	£45,000
North West England	£46,500	£40,000	£50,000
Northern Ireland	£38,500	£36,000	£45,000
Scotland	£45,000	£42,000	£47,000
South East England	£55,000	£50,000	£60,000
South West England	£48,000	£40,000	£55,000
Wales	£45,500	£38,000	£48,000
West Midlands	£44,000	£38,000	£50,000
Yorkshire and the Humber	£43,000	£38,000	£45,000
National average	£46,542	£41,000	£51,250
% increase year on year: 2.3%			

Consultants: Sustainability consultant

Region	Typical 2018	Min 2018	Max 2018
East Midlands	£43,000	£35,000	£45,000
East of England	£51,000	£42,000	£60,000
London	£55,000	£45,000	£60,000
North East England	£41,000	£36,500	£43,500
North West England	£46,000	£40,000	£50,000
Northern Ireland	£37,000	£30,000	£40,000
Scotland	£43,250	£35,000	£50,000
South East England	£43,500	£43,000	£48,000
South West England	£45,000	£40,000	£50,000
Wales	£42,500	£38,000	£45,500
West Midlands	£43,500	£38,000	£46,000
Yorkshire and the Humber	£43,500	£40,000	£47,500
National average	£44,521	£38,542	£48,729
% increase year on year: 1.7%			

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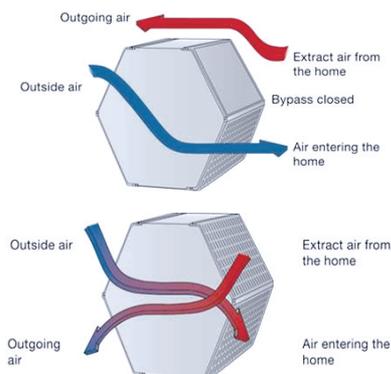
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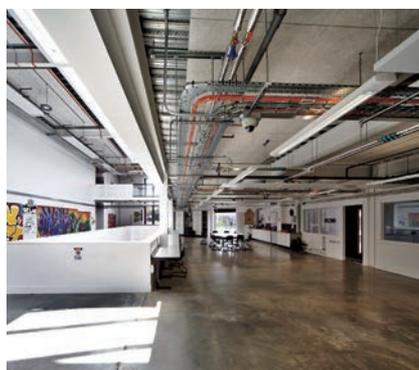
## MVHR in Passive House CPD

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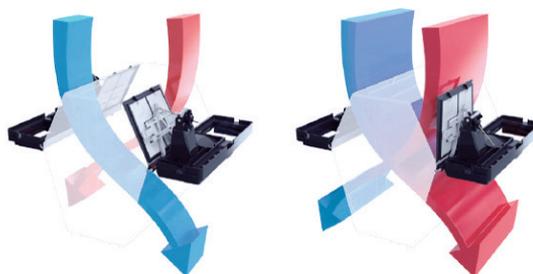
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## Applying ventilation to mitigate home overheating

**This module considers the problems of overheating in domestic buildings, methods to predict realistic overheating risks, and how to establish when this risk requires active cooling in a particular design**

Driven by the desire to reduce winter heating needs, the development of highly insulated, well-sealed homes has acted – together with increases in summer ambient air temperatures – to increase incidences of ‘overheating’, with consequent impacts on occupant health and wellbeing. Establishing the risk of overheating in homes is dependent on an array of factors, making it challenging to predict and compare the performance of different buildings and systems.

This CPD will consider some of the evidence that has confirmed overheating as a significant problem, and will introduce CIBSE’s TM59, which provides a common set of parameters to predict overheating risks realistically and establish when the risks of a particular design would require the inclusion of active cooling.

As highlighted<sup>1</sup> by the UK’s Committee on Climate Change, there are currently around 2,000 heat-related deaths in the UK each year, with much of the increased risk thought to be caused by exposure to high indoor temperatures. BRE’s guidance<sup>2</sup> reported that the 2003 heatwave in Europe resulted in more than 20,000 heat-related deaths, with 2,000 in England alone. In addition, there are predictions of significant increases in UK heat-related mortality<sup>3</sup>, rising from 2,000 deaths per year in 2015 to an estimated 7,000 per year by the 2050s. Mortality is an extreme consequence of overheating, but poor thermal comfort, illness, stress, anxiety, sleep deprivation and reduced productivity and wellbeing can all stem from excessive internal temperatures.

In a study of the risk of heat impacts for London, Katie Jenkins<sup>4</sup> suggests that, by the 2030s, between 59% and 76% of flat-based residents – and 24% to 29% of people in detached properties – could experience overheating during a heatwave. For the 2050s, under assumed projections of change in climate and land use, the values potentially increase to between 80% and 92% in flats, and 56% to 61% in detached dwellings. The estimates of cost rise from a total annual figure of £10m to £50m today, to between £25m and £150m per year by 2050 – and £40m to £350m by 2080.

As highlighted in the recently published CIBSE Technical Memorandum 59 *Design methodology for the assessment of overheating risk in homes*, overheating is dependent on multiple coincident factors. Whether a person suffers heat stress will be influenced by a whole gamut of parameters that relate not only to the actual temperature of their environment, but also to the many other influences that impact on human thermal comfort. This means that not all occupants will concur with their individual environmental assessments, but it indicates the need for a benchmark methodology to undertake meaningful comparisons and form reliable design decisions.

As cited in the literature review<sup>5</sup> for the UK government’s assessment of the risks of overheating in homes, work undertaken by Armstrong shows that the impact (on mortality) of high temperature varied in the different regional climates of the UK. The London area was shown to have the highest threshold and, coincidentally, the highest mean summer temperature (which might indicate a degree of personal adaptation). London data shown in Figure 1 indicates



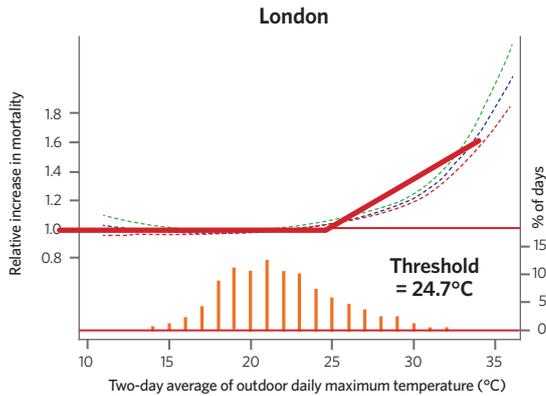


Figure 1: Relative increase in mortality for London inhabitants related to temperature, together with the banded two-day London historic external maximum air temperature<sup>5</sup>

» an upturn in mortality beyond an external temperature of 24.7°C. Armstrong’s work noted that, when attempting to model the impacts, the prediction was improved when it accounted not only for the daily maximum temperature, but also for the daily minimum temperature.

**Reducing the opportunity for overheating**

Around 45% of buildings professionals estimate<sup>2</sup> that there is ‘little or no additional cost’ to incorporating passive cooling measures in new buildings at the design stage. Design measures<sup>2</sup> for homes include: avoiding highly glazed south-facing façades; ensuring a good ventilation-to-floor-space ratio; external shutters; trickle vents; green roofs; and green walls covered in vegetation. Use of passive measures should be the primary means of reducing the risks of overheating and, in many cases, these will be sufficient.

A properly designed and operated mechanical, whole-house ventilation system that supplies and extracts air can ensure air movement around the property, as well as significantly enhance the ventilation rate. When outdoor air is cooler than indoor air, a cooling effect can be realised. Through the integration of a heat exchanger with bypass – to form a mechanical ventilation with heat recovery (MVHR) unit – the supply air temperature may be moderated throughout the year.

There are likely to be residential applications that require some form of augmented cooling to maintain reasonable conditions. A number of possibilities can be explored for further cooling the air, some of which are likely to be more suited – and cost-/energy-effective – when applied in systems serving multiple homes. The following are examples of systems that can also be used in conjunction with a heat recovery device:

**Ground pipes** – where the outdoor air is drawn through underground cavities or pipes.

**Ground to air subsoil exchanger** – where the outdoor intake air is brought through a heat exchanger containing a brine solution that has circulated around a ground coil.

**Indirect evaporative cooling** – when the incoming air is passed across a heat exchanger where, on the other side, external air has been evaporatively cooled (and that cooling humid air is then directly discharged to the atmosphere).

**Surface water cooling** – where the outdoor air exchanges heat with water drawn from a water mass, such as a lake, river or the sea.

**Evaporator coil in the airstream** – containing a cold, low-pressure refrigerant that rejects heat to the external environment via a heat pump/refrigeration process.

As part of a US study<sup>6</sup>, Jennifer Bobb considered the impact of air conditioning as a factor in the incidences of heat-related mortality in US homes. The analysis is not clear-cut, as there are other factors that could have affected the results – such as high air conditioning operating costs on warmer days discouraging use of the systems; and not knowing whether the more vulnerable in the population were those who had actually installed air conditioning. However, the findings indicate a relationship between those US regions with increasing applications of home air conditioning and reduced mortality, including the more temperate areas of the north-western and north-eastern US, which have similar climates to the UK. This indicates that air conditioning (or augmented cooling) could be used in applications where passive measures and outdoor ventilation alone are insufficient to reduce overheating risk adequately. This will incur operating costs, increased energy use and increased urban heating.

Chapter 5 of the recent *UK Climate Change Risk Assessment 2017: Evidence Report* cites accounts indicating that the application of dwelling air conditioning is currently low in the UK, at 3% of homes. This is likely to increase significantly, although, it notes, this would require increases in system energy efficiency and reductions in the installed costs compared with standard air conditioning systems.

Where other methods – including passive measures and MVHR – are impractical or simply unable to maintain reasonable conditions, compact systems, such as that schematically illustrated in Figure 2, are being marketed as a means of providing active cooling, as well as ventilation, to meet this challenge. They employ packaged vapour compression refrigeration systems that cool the supply air when needed and benefit from unitary construction that integrates into whole-house ventilation systems.

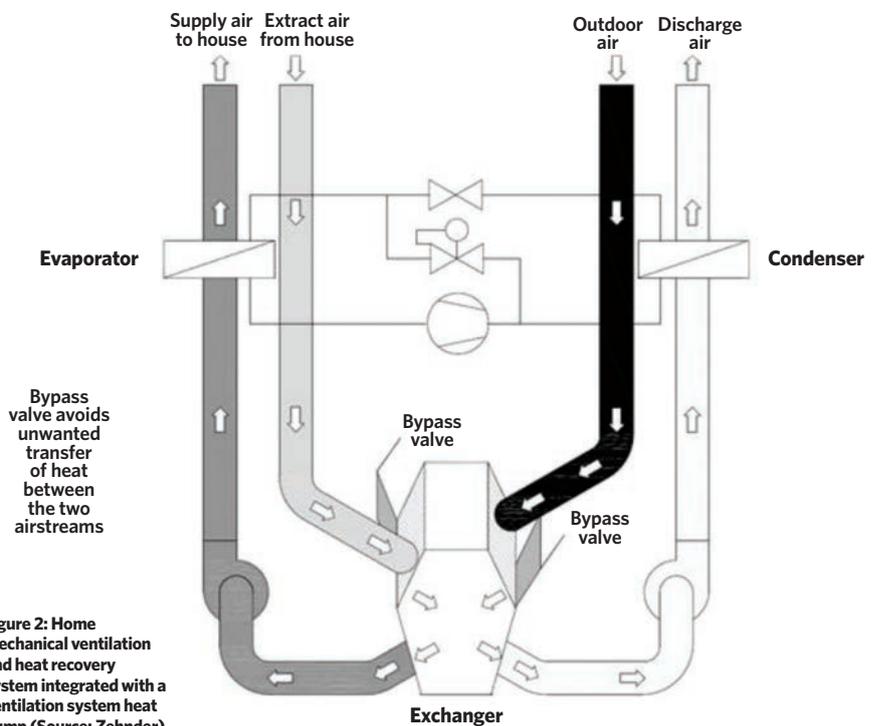


Figure 2: Home mechanical ventilation and heat recovery system integrated with a ventilation system heat pump (Source: Zehnder)

**Determining the risk**

CIBSE’s TM59 domestic overheating risk assessment methodology has been developed – and tested on typical UK projects – to facilitate robust modelling of overheating risks for homes that, although based on UK data, could be evolved for application in other temperate climate zones. It provides a standardised set of inputs and associated methodology that can be applied with commonly used dynamic thermal modelling tools. TM59 is not, in itself, a calculation method, but is guidance to encourage good design that delivers comfortable environments within sensible limits, without being so stringent that it over-promotes the use of mechanical cooling.

The method prescribes standardised inputs that include occupancy profiles, internal gains, window opening and shading profiles, and external design conditions (based on the CIBSE TM59 Design Summer Year, DSY01, 2020s High-emissions 50% scenario) so that meaningful comparisons may be undertaken, based on a common set of conditions. Infiltration and mechanical ventilation rates are based on the particular design parameters for the home under consideration, including natural ventilation if feasible. Residences that are predominantly mechanically ventilated must satisfy the comfort criteria without the MVHR units being in ‘boost’ mode, which can cause noise issues. An unwanted side-effect of this requirement could be to increase the ventilation rates for normal (unboosted) MVHR systems in new homes (operating 24/7), which may have detrimental effects on the building energy use.

- Profiles for the occupancy and equipment gains were developed specifically for TM59 to account for when overheating risk is at its highest – in the early afternoon (likely peak gains) and during night-time (when sleep may be disrupted) – based on occupancy for 24 hours a day, seven days a week, May to September. The profiles provide a common basis for comparison across all assessments that will all include:
- **Occupancy** – derived from CIBSE and ASHRAE data. Bedrooms are assumed to have 24-hour occupancy and other spaces daytime (13 hours per day) use only.
  - **Solar gains through glazing** – any assumed shading must be confirmed as being actually fitted and in use.
  - **Equipment** – the common appliance profiles (in watts) are based on the number of occupants in the residence.
  - **Lighting** – proportional to floor area, but accounting for automatic control. Night-time (6pm to 11pm) is assumed as 2W·m<sup>2</sup>.

Larger or unusual apartments follow the same principles and can apply alternative profiles for specific room types, but these should be clearly identified in the resulting compliance report. The TM59 data and method can also be a useful starting



**Figure 3: A stand-alone unit that supplies cooling to the incoming air and encloses all the required vapour compression refrigeration components in internally mounted housing, connecting with a MVHR system. Heat is rejected to the discharge airstream. (Source: Zehnder)**

point for the assessment of more extensive institutional accommodation, such as care homes and prisons.

To satisfy the recommendations of TM59 for naturally ventilated homes, modelled room operative (comfort) temperatures should not exceed the upper comfort limit by 1K for more than 3% of summer occupied hours. Bedrooms should not exceed 26°C – the temperature above which sleep patterns are disturbed – for more than 1% of the annual hours between 10pm and 7am. For mechanically ventilated homes, the operative temperature should be no more than 26°C for 3% of annual occupied hours. It is not mandatory to comply with TM59; however, the overheating risk should be reported as part of the overall building performance assessment.

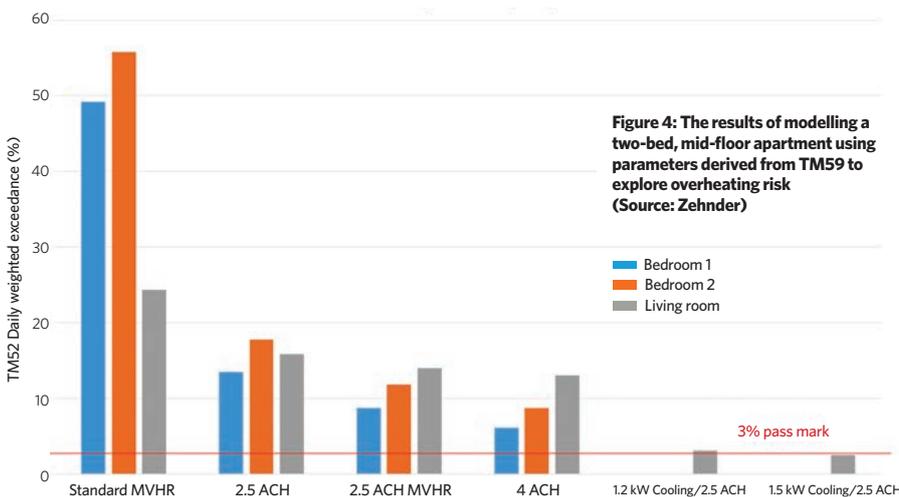
When assessing projects with multiple housing units, the highest-risk dwellings should be identified and assessed. Typically, these include single-aspect, highly glazed, top-floor units with limited window openings. Two case studies of applying TM59 methodology are included in Ashley Bateson’s July 2017 presentation ([bit.ly/CJFeb17CPD](https://bit.ly/CJFeb17CPD)), and show the efficacy of passive design measures and MVHR in controlling overheating risks for those specific examples (an apartment block adjacent to a busy road and a set of exposed high-rise apartments).

The output from a further TM59 modelling example is shown in Figure 3. This is for a 73m<sup>2</sup>, two-bed, mid-floor apartment with a single 39m<sup>2</sup> south-facing – and a 4.5m<sup>2</sup> west-facing – external brick façade (U = 0.18W·m<sup>-2</sup>K<sup>-1</sup>) with a total of 13.2m<sup>2</sup> glazing (U = 1.4W·m<sup>-2</sup>K<sup>-1</sup>, g = 0.6, 15% frame) with no external shading. The apartment includes a combined kitchen and living space, and a bathroom, as well as the two bedrooms, and has a design airtightness 4m<sup>3</sup>·h<sup>-1</sup> @50Pa per square metre of build envelope.

The apartment model was produced for a project located in southern England, and the CIBSE 2016 Southampton DSY1 2020 50th percentile high-emissions scenario weather data was applied. The analysis indicates that, for this particular, challenging application, a standard or oversized MVHR is unable to meet the required overheating criteria that cannot be met by passive means alone. By applying 1.5kW of cooling – for example, with a compact heat pump cooling unit, as in Figure 3 (with the condenser rejecting heat into the discharge air, as in Figure 2) – the apartment is likely to meet the requirements of TM59, with an air flowrate of 2.5 air changes per hour.

© Tim Dwyer, 2018.

■ Turn to page 70 for references.



**Figure 4: The results of modelling a two-bed, mid-floor apartment using parameters derived from TM59 to explore overheating risk (Source: Zehnder)**

# Module 122

February 2018

» 1. How many heat-related deaths are currently estimated to occur in the UK each year?

- A 1,000
- B 2,000
- C 4,000
- D 7,000
- E 20,000

2. In London, what threshold outside temperature was reported as coinciding with a notable upturn in mortality rates?

- A 23.7°C
- B 24.7°C
- C 25.7°C
- D 26.7°C
- E 27.7°C

3. What approximate percentage of UK homes are thought to have applications of air conditioning?

- A Less than 1%
- B 3%
- C 5%
- D 7%
- E 9% or more

4. To comply with TM59 in mechanically ventilated homes, what is the limiting operative temperature that should not be exceeded for more than 3% of annual occupied hours?

- A 22°C
- B 24°C
- C 26°C
- D 28°C
- E 30°C

5. In the example of the packaged cooling unit, how is the heat rejected?

- A Using an air-cooled condenser in the outdoor air
- B Using a ground pipe
- C Using a condenser in the discharge airstream
- D Using a condenser in the intake airstream
- E Using a condenser in an unoccupied room (such as a bathroom)

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### Further reading:

TM59 is freely downloadable from [bit.ly/2n8aQX2](http://bit.ly/2n8aQX2)

There is a valuable presentation by Ashley Bateson that includes some worked applications of TM59 at [bit.ly/2naQTOP](http://bit.ly/2naQTOP)

CIBSE KS16 *How to manage overheating in buildings* gives a convenient overview, with links to other documents.

### References:

- 1 Brown, K, *The hidden problem of overheating*, 8 August 2017, Committee on Climate Change, [bit.ly/2DGi8uw](http://bit.ly/2DGi8uw) - accessed 1 January 2018.
- 2 Dengel, A et al, *Overheating in Dwellings*, BRE, 2016.
- 3 UK Climate Change Risk Assessment - [bit.ly/2DuZTVS](http://bit.ly/2DuZTVS)
- 4 Jenkins, K et al, *Probabilistic spatial risk assessment of heat impacts and adaptations for London*, *Climatic Change*, 124(1-2), 105-117. 2014.
- 5 Investigation into Overheating in Homes - Literature Review DCLG (AECOM) July 2012.
- 6 Bobb, J et al, *Heat-Related Mortality and Adaptation to Heat in the United States* - [bit.ly/2n3Uxe4](http://bit.ly/2n3Uxe4)

March 2018	Health and wellbeing Air conditioning Chilled beams	August 2018	Heat networks Housing Healthcare
April 2018	Data centres Water heaters <a href="#">Schools &amp; education buildings Supplement</a>	September 2018	Ventilation & heat recovery systems Air conditioning
May 2018	Air movement and ventilation Air conditioning <a href="#">Commercial heating Supplement</a>	October 2018	Pipework, pumps & valves <a href="#">Hotel and leisure Supplement</a>
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Send to: [editor@cibsejournal.com](mailto:editor@cibsejournal.com).

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## CIBSE Scotland

### CIBSE Scotland Conference

Opportunities for growth in the building services engineering sector in Scotland

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- Network with like-minded professionals at the conference lunch and drinks reception.

Come to our unique city centre venue in Glasgow and hear about the unique opportunities coming up in our region. We welcome the views of all CIBSE members so join in the debate and share your experiences with your Scottish colleagues.

CIBSE President, Peter Y Wong, will deliver the opening address and will be followed by a day of talks from a wide range of eminent speakers, including: Ann Allen, Executive Director of Estates and Commercial Services, University of Glasgow, Chris Stark, Director of Energy and Climate Change at the Scottish Government, industry representatives Zeb Ahmed, Deputy Managing Director of Bouygues Energies & Services Contracting, Tamsin Tweddell, Senior Partner of Max Fordham, and Ant Wilson MBE, Director at AECOM and CIBSE Silver Medal holder.

Toby Jeavons, Associate Partner at Rogers Stark Harbour & Partners will provide an Architect's perspective, and Alistair Murray, UK leader of Arup Fire will talk about issues concerning fire safety and protection in buildings.

**Tuesday 20th  
March 2018**  
The Technology Innovation Centre, University of Strathclyde, Glasgow

Visit: [www.cibse.org/scotlandconference](http://www.cibse.org/scotlandconference) for more information and to book.

# PRODUCTS & SERVICES

## Belimo introduces new range of sensors >

Belimo has launched new and innovative sensors, which promise to complement its actuators and valves, optimise system performance and improve energy efficiency. The sensors can be integrated into all major building automation and control systems (BACS).

The universal compact enclosure design features an intuitive snap-on cover and detachable mounting plate, which makes installation and commissioning easy. BACnet and Modbus communication protocols offer superior application data access.

Belimo offers the highly resistant sensors for measuring temperature, humidity, pressure, CO<sub>2</sub> and VOC (volatile organic compounds) for pipe, duct and outdoor applications.

The sensors have a five-year warranty and conform to NEMA 4X / IP65 requirements and are UL compliant. They deliver reliable and accurate readings over the entire lifecycle of the building.

■ Call 01932 260460, email [sales@belimo.co.uk](mailto:sales@belimo.co.uk) or visit [www.belimo.co.uk](http://www.belimo.co.uk)



## Hammersley House refurbishment features underfloor air conditioning >

Underfloor air conditioning specialists AET Flexible Space has completed another West End project in London, at Hammersley House, 5-8 Warwick Street. AET Flexible Space worked in conjunction with appointed M&E contractor WBS Mechanical Services to deliver the underfloor air conditioning system specified for the 11,000ft<sup>2</sup> of Grade A office accommodation on floors 1-4. The final system specification at Hammersley House is a CAM-V direct expansion (DX) system, with underfloor supply air and return air at high level.

■ Visit [www.flexiblespace.com](http://www.flexiblespace.com)



## Sodeca Fans UK welcomes new smoke control specialist >

John Paul Reeves, who is chair of the Institute of Fire Engineers Smoke Ventilation Special Interest Group, has taken on the role of smoke control consultant at Sodeca Fans UK. He will help clients with design on all aspects of smoke control, including extract, pressurisation and car park ventilation systems.

For design advice, or a technical presentation on smoke ventilation, contact John Paul Reeves.

■ Call 07399 818698 or email [jpreeves@sodeca.co.uk](mailto:jpreeves@sodeca.co.uk)

## > Weber spray concrete defends Nothe Fort at Weymouth Harbour

High performance spray repair concrete by Saint-Gobain Weber has been used to fortify a sea wall that acts as coastal defence to Nothe Fort at Weymouth Harbour.

Webercem spray DS and RS were used – the RS ready-to-use, dry-sprayed concrete is able to achieve rapid repairs to structures within tidal zones, dock walls, jetties and sea walls.

It achieves a permanent repair where time constraints demand the earliest possible strength gain.

It can be applied up to 100mm thickness.

■ Call 08703 330 070 or visit [www.netweber.co.uk](http://www.netweber.co.uk)



## > Be relaxed about building services design

The complexity of designing, installing and maintaining central heating in multi-occupancy low-rise buildings can potentially now be eliminated.

Gilberts has created a solution that combines appropriate ventilation with heat boost.

The solution focuses around Gilberts' Mistrale Fusion (MFS) unit with an integrated LPHW coil. Just two standard MFS128 (one at either end of the room), or one MFS256, will ventilate and warm a standard 32-pupil classroom to all regulatory air quality requirements.

■ Call 01253 766911 or email [info@gilbertsblackpool.com](mailto:info@gilbertsblackpool.com)



## < Gripple presents next generation of wire rope suspension solutions

Gripple has developed a complete solution for the installation, in all applications, of HVAC, mechanical and plumbing services, also delivering increased speed, higher load performance and easier adjustment.

Replacing the Gripple Trapeze and Trapeze Plus products, the UniGrip combines their functionality and best features and adds to them. With three models, UniGrip boasts an increased load rating performance up to 33%, each with a greater safe working load of 5:1.

■ Call 0114 2288 713, email [g.bills@gripple.com](mailto:g.bills@gripple.com) or visit [www.gripple.com](http://www.gripple.com)





### ✓ Papworth has Grundfos pumps at its heart

Papworth Hospital is the UK's largest specialist cardiothoracic hospital and its main heart and lung transplant centre.

With responsibility on the shoulders of a complex facility, it is not surprising that every aspect of its performance must meet the highest levels and attain the best energy standards. This is also true for the myriad of Grundfos pumps that operate in the recently updated energy centre, whose role it is to maintain the ideal ambient temperature and deliver water at the required temperature, ensuring there is enough to meet the demands while maintaining the pressure in the system.

The options that have been selected to fulfil all these roles are from the wide range of Grundfos pumps. They will ensure all the various functions they support will continue to deliver optimal performance 24/7.

The ability to successfully deliver complex solutions is something that both Papworth and Grundfos strive to attain.

■ Call 01525 850000  
or visit [www.grundfos.co.uk](http://www.grundfos.co.uk)



### Climaveneta Powermaster becomes part of Mitsubishi Electric ✓

Mitsubishi Electric has announced the absorption of Climaveneta Powermaster, making it a branded product family within Mitsubishi Electric's portfolio.

The move allows Mitsubishi Electric to access the UK's chiller market with a product range that will be supported by its strong commitment to quality and service.

'This announcement shows how serious we are about delivering a complete solution for any building or sector,' said Deane Flint, sales director for Mitsubishi Electric.

■ Visit [www.airconditioning.mitsubishielectric.co.uk](http://www.airconditioning.mitsubishielectric.co.uk)



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### ◀ Helvar launches new 321 multisensor

Helvar has introduced the 321 Multisensor - a compact, cleverly engineered device that sets a new standard for reach and reliable motion sensitivity in passive infrared (PIR) technology. Key features include a superior performance through high sensitivity and multidirectional coverage; accurate occupancy and motion detection over an extensive 8m x 6m area at 2.5m installation height; discreet, in-ceiling aesthetic; programmable constant light control for energy efficiency and 5mA Dali power consumption.

■ Visit [www.helvar.com](http://www.helvar.com)

### Best on energy for exterior and interior applications ✓

Rinnai's Infinity range of A-rated continuous flow gas-fired water heaters - which includes models specifically designed for domestic/light commercial use - guarantees the highest efficiencies and lowest running costs at consistent temperatures 24/7.

Rinnai units cater for projects that need high volumes of water at intermittent times of day delivered at accurate temperatures.

Rinnai's Infinity multipoint 16i water heater eliminates the problem of sudden changes in water temperature, resulting in cold showers or scalding hot baths.

■ Visit [www.rinnaiuk.com](http://www.rinnaiuk.com)



### ◀ Luceco lights Kendal Rugby Union Football Club, Mintbridge

Luceco has recently supplied LED luminaires for an £11m sports facility, the new home for Kendal Rugby Union Football Club (KRUF). The new facility benefits from two large hospitality areas and a viewing balcony overseeing two pitches - one grass and one all-weather surface - a restaurant, physio practice and a community gymnasium. LED 600 x 600 square LuxPanels were installed in offices and consulting rooms, with IP65 rated Circular LuxPanels used in changing rooms, shower facilities and WCs. LuxPanel requires no maintenance over its lifetime and has more than 50,000 hours of operational life.

P Wright Electrical, based in Kendal, was the electrical contractor for the overall project and undertook the installation. Paul Wright said: 'The client was looking to create a sports hub for Kendal, as well as a new home for the Kendal Rugby team. Working with Luceco, we installed more than 560 LED luminaires, including platinum downlights in the gym, corridors and reception areas and LuxPanels in the offices and changing rooms. LED Dali dimmable dual switched downlights were used in the lounge bar and main function rooms, with colour changing LED strips to give a modern and interesting twist in those areas and something special for hospitality events.'

The new facilities at Kendal RUFC will ensure the Black & Ambers enjoy a state-of-the-art venue to continue their club's flying success.

■ Call 01952 238100, email [uk\\_sales@luceco.com](mailto:uk_sales@luceco.com) or visit [www.luceco.com](http://www.luceco.com)

### SPC revamps leading coil specification tool

SPC has launched a new and improved version of its original tool for coil specification and costing. Now accessible on any device, its online coil selector helps specifiers to get an instant quote, BIM objects and data for sizing related heating and cooling system equipment, for any project.

Available for free via <http://coil.spc-hvac.co.uk>, the tool can be accessed directly without downloading the programme, and improved layout enables users to manage a portfolio of projects.

■ Visit [www.spc-hvac.co.uk](http://www.spc-hvac.co.uk)



### Smith's adds a range of radiant panels

Smith's Environmental Products UK has announced the introduction of a range of radiant panels, called Sargasso.

The range comes in two stylish designs, Sargasso A and Sargasso S. The product is designed to be installed in a ceiling grid in place of traditional ceiling tiles. They form part of a 'wet' heating system. The hot water is fed to the Sargasso radiant panels and approximately 85% less water is required compared to a traditional systems.

■ Call 01245 324900, email [sales@SmithsEP.co.uk](mailto:sales@SmithsEP.co.uk) or visit [www.SmithsEP.co.uk](http://www.SmithsEP.co.uk)



### Gripple strikes again with a revolutionary system to speed up and ease services installation

Gripple has launched Fast Trak, which is designed for installation of mechanical and electrical services, where ceiling space is limited.

Fast Trak, a pre-fabricated, trapeze bracket, allows for flexible installation of electrical containment, ductwork, pipework and other mechanical services. Fast Trak is adaptable because the brackets can be moved along the tracks to facilitate any position change. Up to six times faster to install than traditional methods, including threaded rod and channel, the product offers tool-free adjustment.

■ Call 0114 2288 623 or email [m.kimberley@gripple.com](mailto:m.kimberley@gripple.com)

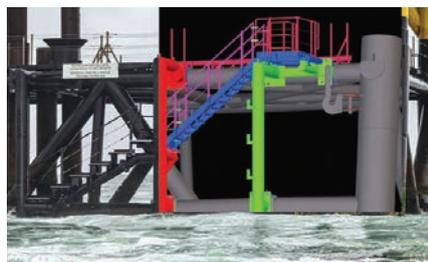


### Tekla structures sails ahead on offshore projects

Pinnacle Consulting Engineers has used Trimble's Tekla Structures on two offshore projects, thanks to it being able to handle the most complex of structures, while creating accurate 3D models.

Models generated with Tekla software contain accurate, reliable and detailed information needed for BIM and construction execution. Tekla Structures was created to improve how users work in their own offices and with their partners by creating more accurate ways of streamlining collaboration between all parties.

■ Visit [www.tekla.com/uk/solutions](http://www.tekla.com/uk/solutions)



### New selection of fan coil units launched by Smith's

Smith's Environmental Products UK has introduced a new range of fan coil units, called Aegean.

The Aegean range is available in 235mm and 265mm horizontal versions and a vertical 500mm version. A 180mm horizontal version will be available in spring 2018. The Aegean range provides heating and cooling solutions for a wide range of applications incorporating the latest EC motor technology, which can result in running-cost savings as high as 80%.

■ Call 01245 324900 or email [sales@SmithsEP.co.uk](mailto:sales@SmithsEP.co.uk)

### Human-centric lighting for all

Helvar has introduced Illustris Power, an elegant, new, touch-sensitive lighting control solution designed for installation into all types of single room application; from boardrooms and meeting rooms, through to open plan offices and showrooms.

The system delivers energy efficient, human-centric lighting in an easy to install package that is cost-effective, stylish and intuitive to operate. Illustris Power brings 'out-of-the-box', intuitive lighting control to any compatible room without the need for additional programming.

■ Visit [www.helvar.com](http://www.helvar.com)



**Panasonic launches new warranty scheme >**

The warranty scheme is designed to offer options for installers to choose from – standard three years, extended five years and extended+ seven years.

For installers to give their customers the standard three-year warranty on products from Aquarea Air to Water ranges, they must show a knowledge and understanding of heat pumps.

For the extended warranty period of five years, installers will need to complete a Panasonic training course with an assessment test.

■ Visit [www.aircon.panasonic.eu](http://www.aircon.panasonic.eu)



**Warwick University – case study >**

Rehau is supplying heating and cooling solutions to the art education developments at the University of Warwick, using its thermally activated building structure (TABS) system.

A number of lecture rooms and office spaces require a supplementary cooling system. To deliver this, Rehau was approached to design a TABS system suitable for the university.

The final design was a circuit system, incorporating 3,700m<sup>2</sup> of pipework installed within every concrete slab over five floors to provide supplementary cooling.

■ Visit [www.rehau.co.uk/tabs](http://www.rehau.co.uk/tabs)



**< Oventrop renewables are game, set and match for new tennis centre**

Graves Tennis and Leisure Centre is a leisure facility located in Sheffield.

The centre uses a huge amount of hot water and Oventrop was selected by mechanical contractors NG Bailey to deliver the full design supply and installation of a 'Solcos' solar thermal hot water system to help meet the demand and cut carbon emissions.

20m<sup>2</sup> of Oventrop MQ high efficiency, commercial flat plate collector was selected and mounted on pre-fabricated mounting frames.

■ Call 01256 330441 or e-mail [sales@oventrop.co.uk](mailto:sales@oventrop.co.uk)



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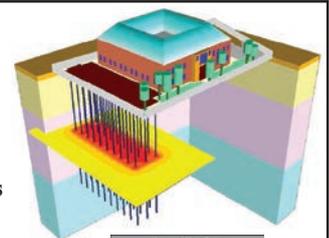
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**Associate Electrical Engineer Nottinghamshire, £60,000 + bens**

This East Midlands market leader are an ambitious, dynamic consultancy who can offer the successful candidate an excellent platform to progress their career and play an integral role in the future success and growth of the business. To be considered for this role you must have experience of leading MEP design projects within building services in the UK, have managed projects design engineers and played an integral role in maintaining existing and developing new client relationships. Ref: 4779

**Senior Mechanical Design Engineer Kent, £35 - £40 p/h**

This multi-disciplinary consultancy is a front runner of engineering design. As a result of continuing successful project wins there is a requirement for a Mechanical Engineer within the Kent Office. You will gain exposure to working on a portfolio of commercial, educational and residential schemes. Ref: 4792

**Mechanical Projects Lead London, £50 - £60k + bens**

A major international multi-disciplinary practice with an impressive portfolio of award winning projects is seeking an experienced leader to design, coordinate, and deliver mechanical building services on a variety of high profile projects. For over 50 years this company has delivered outstanding holistic and sustainable buildings and seek a forward thinking and creative individual to join their team. Ref: 4760

**Int/Snr Fire Engineer London, £35k - £45k + bens**

A multi-disciplinary consultancy is seeking a Fire Engineer to join their rapidly growing team. The role will include preparing fire strategies in accordance with BS 9999 and ADB, liaising with Building Control Authorities, Architects, and Project Managers to help develop and design buildings in accordance with part B. Exposure to multiple sectors and some of London biggest projects guaranteed. Ref: 4714

**Associate Mechanical Engineer Dubai, AED 540k - 560k p/a + bens**

An award winning multidisciplinary consultancy with offices in the Middle East, Africa, Oceania, and Asia are seeking a knowledgeable, client facing engineer to lead iconic projects and the mechanical team. You will be working on international high-profile projects including commercial, retail, high-rise, and mixed-use developments and be responsible for winning work and developing client relationships. Ref: 4787

**Senior Electrical Design Engineer Central London, £38 - £42 p/h**

As a global service provider specialising in providing expert solutions in design and operations to the data centre and digital world are seeking a Senior Electrical Engineer. Successful candidates will need to demonstrate recent electrical building services design exposure specifically within data centres. Ref: 4791

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# EVENTS

## NATIONAL EVENTS AND CONFERENCES

### **CIBSE Building Performance Awards** 6 February, London

The winners of the 14 awards for 2018 will be unveiled. Join host comedian Mark Watson to celebrate excellence and achievements in building performance, and network with more than 700 guests from across the sector.  
[www.cibse.org/bpa](http://www.cibse.org/bpa)

### **Society of Light and Lighting: Light Bites** 22 February, Bristol

Continuing the 2017-18 SLL Lighting Knowledge Series, with peer-reviewed, bitesize presentations focusing on: design, build, specify and future. Speakers will include: Lee Thomas and Nick Van Tromp, from Fagerhult; Steve Shackleton, from Zumtobel Group; Helen Loomes, from Trilux; and Roger Sexton, from Xicato. The series continues through to June 2018.  
[www.cibse.org/sll](http://www.cibse.org/sll)

### **CIBSE TRAINING**

For details, visit [www.cibse.org/training](http://www.cibse.org/training) or call 020 8772 3640

### **Mechanical services explained** 6-8 February, Manchester

### **Fire-detection and alarm systems for buildings** 6 February, London

### **Energy efficiency building regulations: Part L** 6 February, Birmingham

### **Fire sprinkler systems: Design** 7 February, London

### **Energy Savings Opportunity Scheme (ESOS)** 8 February, Manchester

### **Introduction to combined heat and power (CHP)** 9 February, London

### **Building services one-day overview** 9 February, London

### **Air conditioning inspection for buildings** 20 February, London

### **Low Carbon Consultant design training** 20-21 February, Leeds

### **Building services explained** 21-23 February, Manchester

### **Surface water source heat pump systems: An introduction** 21 February, London

### **Surface water-source heat-pump systems: Implementing** 22 February, London

### **Standby diesel generator** 22 February, London

### **Emergency lighting to comply with fire-safety requirement** 23 February, London

### **Understanding and application of psychrometric charts** 23 February, London

### **Fire safety in purpose-built blocks of flats** 27 February, London

### **Energy audits and surveys** 1 March, London

### **High voltage (11kV) distribution and protection** 2 March, London

### **Gas safety regulations (designing for compliance)** 2 March, London

### **Energy efficiency building regulations: Part L** 6 March, Manchester

## CIBSE GROUPS, SOCIETIES AND REGIONS

For more information about these events, visit: [www.cibse.org/events](http://www.cibse.org/events)

### **North East: Is lighting more psychology and art than science?**

6 February, Newcastle upon Tyne  
Fagerhult's Henrik Clausen looks at research on lighting and psychology, and finding the balance between light and art.

### **SoPHE: Blue roofs** 6 February, London

A talk by ABG.

### **Lift Group: AGM and evening meeting** 6 February, London

Introduction to BS 8486 standards and review of BS 8486-3, with opportunity to contribute to Lifts Group consultation response.

### **ILEVE/BOHS annual LEV conference**

6-7 February, Hinckley  
Two-day programme on 'Extracting the best practice', delivering insight into the topics affecting local exhaust ventilation control and its role in reducing industrial disease.

### **Southern region: 'Double up' on water safety** 8 February, Brighton

With speaker Daniel Pitcher, managing director, Water Hygiene Centre.

### **SLL & North West: Technical seminar on**

### **DIALux evo lighting software**

8 February, Manchester  
Seminar will explain the 'building smart' strategy and the integration of the lighting designer in the digital design.

### **South west: Regional dinner**

9 February, Bristol  
Celebrating the South West region's 70th anniversary.

### **Yorkshire: Leadership – the opportunity** 21 February, Leeds

Geoff Prudence on the importance of good leadership skills and collaboration.

### **Lighting for Transport and Infrastructure Conference**

22 February, London  
Event, supported by the Society of Light and Lighting, which will be exhibiting with copies of the new *Lighting Guide 15: Lighting for Transport*.

### **HCNW: The legal angle** 26 February, Milton Keynes

An interactive workshop, with speaker Stephen Rockhill, on how engineers could reduce their exposure with a better understanding of the law.

### **North West: CIBSE Guide E** 28 February, Manchester

After the update to CIBSE Guide E, this presentation will look at revisions to chapter 6 (fire dynamics) and chapter 10 (smoke ventilation).

### **East Midlands: Annual dinner** 2 March, Nottingham

Opportunity to network across the industry in a relaxed, entertaining evening.

### **Yorkshire region: Helping each other flourish** 9 March, Leeds

Event incorporating the regions International Women's Day celebration, with speakers covering ways in which we can realise our potential and help others to achieve theirs.

### **Scotland Region: Conference – Opportunities for growth in the building engineering sector in Scotland**

20 March, Glasgow  
One-day conference exploring opportunities for the growth of the sector in the region.

[www.cibse.org/scotlandconference](http://www.cibse.org/scotlandconference)

## HIGHLIGHT



Geoff Prudence will speak at the Yorkshire event on 21 February

## Ecobuild 6-8 March, ExCel, London

This free-to-attend conference and exhibition returns to ExCel, to showcase the latest construction products and technologies, while delivering a high-quality seminar programme.

Split across eight 'futurebuild' districts – each dedicated to a distinct built-environment community – the event will offer updates on the latest technology, innovations in materials, and the freshest thinking from 450 exhibitors.

Hywel Davies, CIBSE technical director, will be speaking in the Clean Growth Strategy session at 10.30am on 6 March, while Julie Godefroy – head of sustainable development at CIBSE – will also speak on that day, at the session on Biophilic Design: Integrating nature into our workplaces, at 4.30pm.

The CIBSE Green Infrastructure Design Challenge 2018 winners will be announced at 5.30pm. Visit CIBSE on stand C174.

For more information and to register, visit [www.ecobuild.co.uk](http://www.ecobuild.co.uk)





# Technical Symposium 2018



## Technical Symposium 2018

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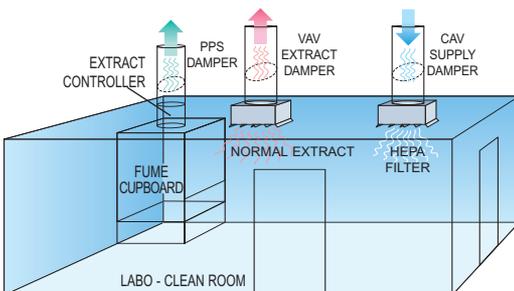


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