CIBSE JOURNAL

CIBSE

The official magazine of the Chartered Institution of Building Services Engineers

April 2016

BRICK BY BRICK

Material forensics at the heart of an award-winning Clapham retrofit

DOMESTIC WOES
The causes of poor energy performance in housing revealed

PERFECT BINDING
The mutual benefits of apprenticeships for engineers and students

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Contents

NEWS

OPINION

Read the Education and Schools Special
with this issue and online at
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Features

SPECIAL FEATURES

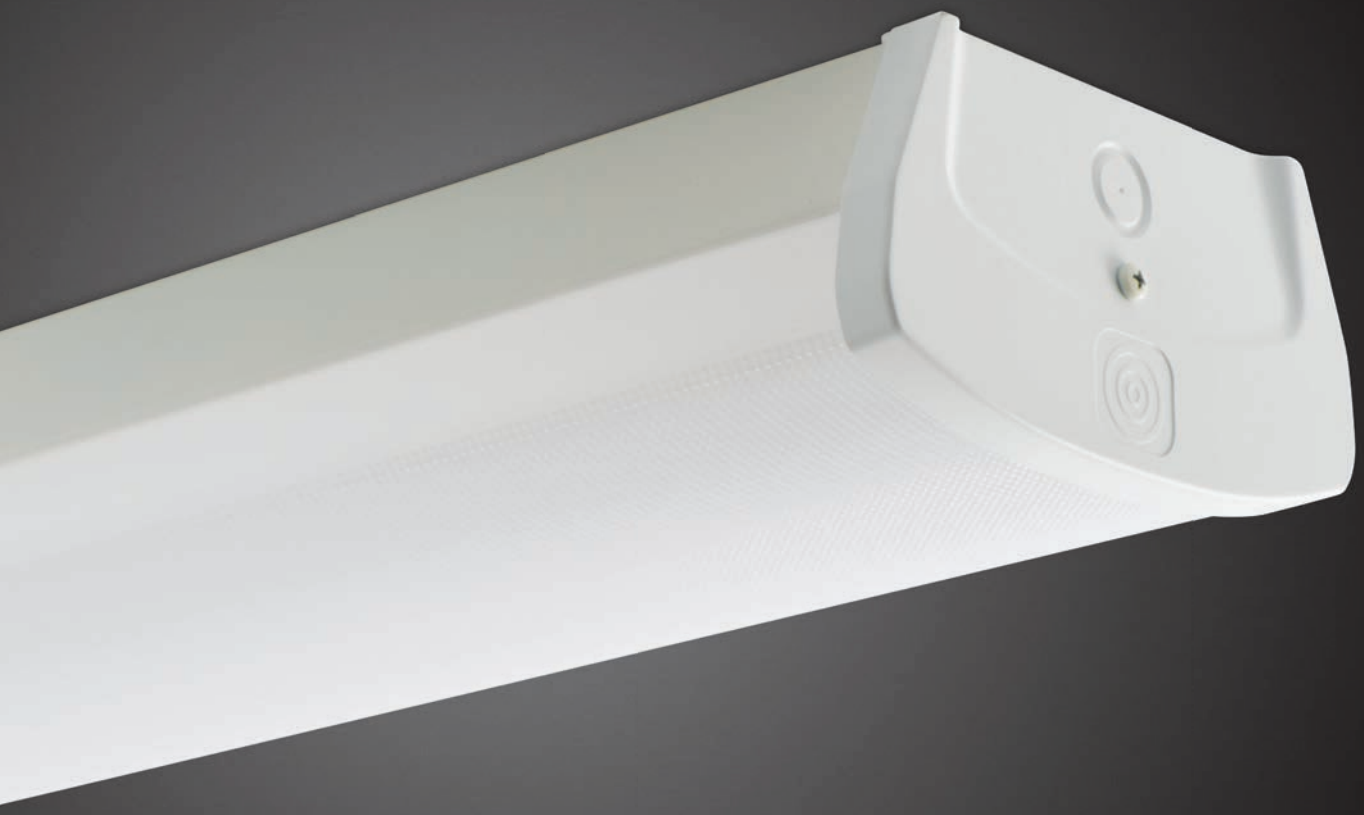
LEARNING

CLASSIFIED

PEOPLE AND JOBS

Luceco product installation guide:

1. **Fit**
2. **Forget**



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Fit for purpose

Ecobuild 2016 hosted a series of presentations that gave a strong hint of what might replace the Green Deal and zero carbon homes initiatives abandoned by the government last year. BRE chief executive Peter Bonfield outlined some of the key recommendations in the upcoming review *Every Home Matters* (page 18), including a call for training and accreditation schemes for assessors and installers, and a code of conduct for participating firms.

The idea is to protect consumers from inappropriate energy efficiency measures and retrofit cowboys. Liz Male, who is leading the review's skills and training workstream, said that a holistic approach was needed for low-energy homes, and that standards and guidance had to be underpinned with an understanding of building physics. This is encouraging, and will help minimise risks – such as damp – caused by the wrong kind of insulation in the wrong place.

The review is also set to recommend that a database of housing types be established to allow industry to learn from previous retrofits. This should help designers identify what measures have already worked (or not worked) in similar homes.

Arboreal Architecture's retrofit of a Victorian Clapham townhouse shows what can be achieved when you understand the existing fabric of the home. The architect's forensic approach helped it scoop the Residential Project of the Year at the CIBSE Building Performance Awards (see page 22).

> The successful retrofit shows what can be achieved with a scientific approach

'To improve the thermal performance, we had to understand what we were dealing with before we started developing the design,' says Arboreal director Harry Paticas. The practice carried out U value monitoring, an air-tightness test and thermographic survey, and monitored interstitial temperatures and moisture gradients for external walls.

With this information, Arboreal and building services engineer Alan Clarke were able to carry out a sensitive restoration, while ensuring appropriate levels of insulation. In all, 12 types of insulation were used to ensure the façade was water permeable, whatever the thickness of the brick, and whatever direction the walls faced.

Sensors were installed to check performance in operation. These identified an incorrect setting for the extract ventilation, which was leading to higher than expected relative humidity.

The successful retrofit shows what can be achieved with a scientific approach, something we hope the authors of Bonfield's review will reflect in their soon-to-be published recommendations.

Alex Smith, editor
asmith@cibsejournal.com

NEWS

All the latest news from around the building industry

Revolution under way in renovation

Green Building Councils (GBCs) across the EU have launched what is claimed to be the world's largest collaborative building renovation project.

The 'Build Upon' project consists of 80 events that aim to bring together more than 1,000 organisations to improve the performance of buildings, which account for 36% of the EU's total CO_2 emissions. It seeks to help countries develop the 'national renovation strategies' that are required, under EU law, to be in place by 30 April next year.

The €2.35m (£1.85m) project, funded by the EU's Horizon 2020 research and innovation programme, is led by GBCs from 13 countries, but not the UK. It is supported by the World GBC's Europe Regional Network.

Central and local governments, construction companies, manufacturers, energy providers, banks and NGOs are all participating in the programme.

Terri Wills, chief executive of the World GBC, said existing buildings were one of Europe's biggest climate-change challenges, and that 'nothing short of a renovation revolution' was needed.

Defra faces court action over air-pollution levels

- **Urban air quality also becoming serious issue for building services professionals**

ClientEarth has started legal proceedings against the government because of its failure to tackle rising levels of air pollution. The legal firm has condemned a strategy by the Department for Environment, Food & Rural Affairs (Defra) as falling 'far short' of the action necessary to comply with a Supreme Court ruling.

Ministers were told by the court to come up with a final plan to deal with high levels of pollution across many parts of the UK by 31 December last year. However, they now say they will not be able to meet legal air-quality levels until at least 2025.

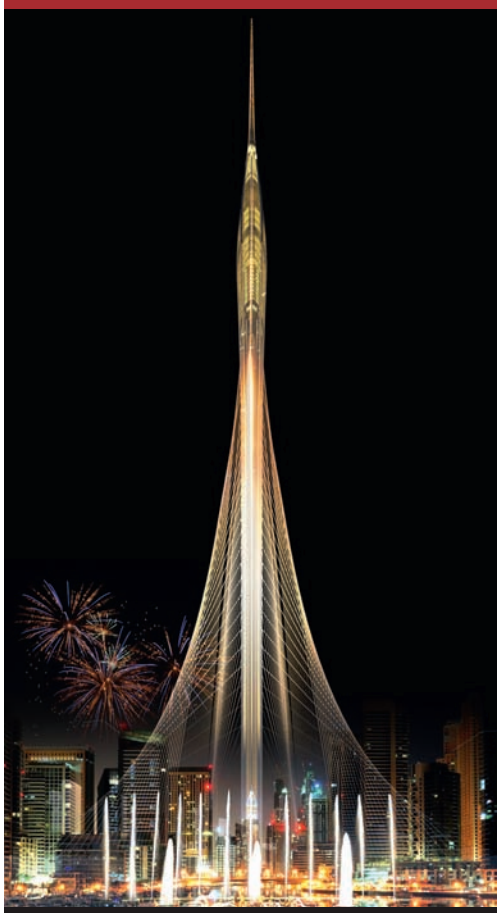
ClientEarth chief executive, James Thornton, said: 'Despite an order from the UK's highest court, despite tens of thousands of premature deaths in this country every year – and despite clear evidence to show air pollution has a terrible effect on the health of vulnerable groups like children – the government has consistently ducked its responsibility to ensure our right to clean air.'

The Building Engineering Services Association (Besa), meanwhile, has set up a pan-industry indoor air quality (IAQ) initiative, and is working on guidance for building owners and engineering firms.

'Many UK cities are in clear breach of EU air-quality standards,' said Besa's head of sustainability, David Frise.

Tim Dwyer, *CIBSE Journal* technical editor, said: 'Engineers can moderate the adverse influences of internal effects on IAQ but, as with any cocktail, the room air mix will be dependent on the quality of the base liquor - the outdoor air.'

CALATRAVA SOARS WITH DUBAI TOWER WIN



Santiago Calatrava Architects and Engineers has won a competition to design a tower in Dubai Creek Harbour. ChapmanBDSP participated as mechanical, electrical and public health consultant on the competition entry, and advised on environmental design and engineering. The tower will be built by Emaar Properties – the developer behind the Burj Khalifa – in partnership with Dubai Holding. The winning entry aims to fuse the heritage of the UAE with modern, sustainable design.

EC updates Rehva on efficiency

The European Commission has presented a review of its energy efficiency policy to representatives of the Federation of European Heating, Ventilation and Air-conditioning Associations (Rehva).

The Directorate General for Energy discussed the Energy Efficiency and Energy Performance of Buildings directives. CIBSE's head of sustainability, Sara Kassam, was part of the Rehva delegation.

Bills could be slashed by storage

Storage systems could cut the UK's energy costs by £2.4bn a year by 2030, according to a report supported by the Department of Energy & Climate Change (Decc) and the Scottish government.

The Carbon Trust and Imperial College London carried out 12 months of analysis, which led them to suggest that storage technologies could cut consumers' bills by £50 a year in a report funded by E.ON, SSE and Scottish Power. Total savings could be as high as £7bn, including £5bn 'primarily from improved use of existing generation assets' and reduced demand for new power-generation capacity.

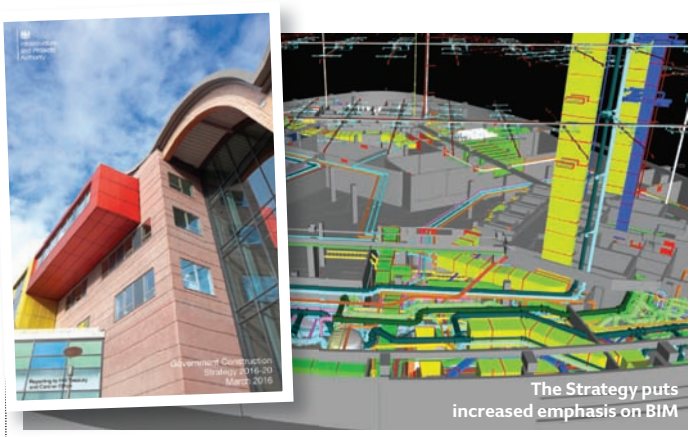
However, the current market does not provide the right conditions for energy storage, according to the report, which highlighted a series of 'core barriers to deployment'.

The authors claim most of the necessary regulatory reforms could be 'cost neutral', requiring no additional funding from the government. They have called for a 'clear and comprehensive strategic approach to energy storage and other forms of flexibility'.

Carbon Trust director of innovation, Andrew Lever, said an outdated market framework hindered deployment, and a rethink was needed to combat the broken value chain of energy storage.

Government to ramp up BIM skills and Soft Landings

- **Government strategy sets out action plan to deliver efficiency savings of £1.7bn**


The Strategy puts increased emphasis on BIM

There is no sign of the government softening its position on BIM, a cabinet construction strategy report has confirmed.

According to the *Government Construction Strategy 2016-20*, published last month – setting out plans for projects worth £163bn – the government sees increasing use of digital technology, including building information modelling (BIM), as one of its principal objectives for the coming years.

The Strategy sets out its intentions to develop skills in government departments to derive further benefits from BIM. It states that it wants to use Publicly Available Specification (PAS) 1192-5 to ensure security will be at the heart of BIM and how it is delivered.

The document said embedding BIM Level 2 and increasing its maturity across government would enable departments to gradually move towards BIM Level 3 under the remit of the Digital Built Britain Strategy.

But the Strategy is vague about the timeframe for the adoption of BIM Level 3, saying only that it will be 'at a later date'.

The document also recognises that skills shortages are a threat to public spending control, and will 'lead to inflation and reduced productivity', but fails to detail how they will be mitigated.

Emphasising its commitment to Government Soft Landings (GSL), the Strategy points out that the GSL Working Group will review departmental progress in implementing GSL, developing departmental action plans to further embed its processes and procedures.

The government predicts efficiency savings of £1.7bn over the course of this Parliament by implementing the actions in the Strategy.

Hywel Davies, CIBSE technical director, said: 'It is good to see that the potential threat of skills shortages to the government investment programme is recognised. The continued emphasis on Government Soft Landings to improve government's ability to measure the performance of its built assets is also welcome.'

Osborne abolishes CRC, but offers boost to energy storage innovation


TWOCOMS / SHUTTERSTOCK

The Carbon Reduction Commitment (CRC) is to be abolished by 2019, the Chancellor, George Osborne, confirmed in last month's budget. He also announced 'at least £50m' to fund a five-year programme of innovation in energy storage, demand-side response and smart technologies.

The CRC, a mandatory scheme designed to improve the energy efficiency of large organisations, will be replaced by an increase in the Climate Change Levy (CCL), which taxes businesses for the energy they use in three years' time. The move follows the Chancellor's controversial decision last year to cancel renewable energy's CCL, and was flagged as part of a wider effort by the Treasury to simplify the energy tax regime.

Many business leaders had denounced the CRC as a stealth tax. However, a number of industry observers said the Chancellor had missed an opportunity to make energy-efficiency measures part of the government's infrastructure plans. This would have allowed them to be funded out of taxation. Melanie Leech, chief executive of the British Property Federation, said: 'It is very welcome to see a confirmed move towards a simpler kind of energy taxation system, one that represents a more direct incentive at building level for the owner and occupier to collaborate on improving energy and carbon performance, and a welcome reduction in accompanying administrative burden.'

Big Apple aims to cut energy in half

New York City Council has passed legislation aimed at cutting its building energy consumption by 50%.

The authority has amended its Leed law so that buildings and major retrofits will now need to achieve Leed Gold standard. This is to be backed up by the first data-driven energy targets in the US, which rely on a new type of metric for measuring energy use and carbon emissions from city buildings.

The council owns 5% of the city's building stock, but private sector designers and builders will also need to create 'a new generation of hyper-efficient buildings', according to officials, who said this would have an international implication because many firms based in the city have global interests.

MPs form unlikely alliance on VAT

The Budget debate saw an unlikely alliance between a group of Eurosceptic conservative rebels and the Labour front bench to protect the 5% VAT rating of energy efficient products.

The European Court of Justice ruled in June 2015 that the reduced rate levied by the UK on energy efficient products – such as insulation materials and solar panels – was a breach of the EU VAT Directive.

Labour tabled an amendment to the Budget that proposed retaining the current rates, and this was supported by Eurosceptic MPs, including Bernard Jenkin, Peter Lilley, Graham Brady and Jacob Rees-Mogg.

They used the debate on the measure to emphasise that the UK is bound by the EU VAT Directive, rather than to argue the merits of reduced VAT rates for energy efficient products, and the amendment was not voted on, but the government had previously indicated in briefings that it would not oppose it.

The EU Commission has announced a VAT Directive review, which may include permitting member states greater flexibility over rates.

The current VAT rate of 5% remains in force for now.

Movers and makers

Send your job moves to **editor@cibsejournal.com**

Max Joy has been appointed the new managing director of Grontmij UK. He joins direct from the British Army, in which he served for 28 years – the last three at Army Headquarters, Andover, where he was assistant head of capability development equipment support. A chartered mechanical engineer and Fellow of the Institute of Mechanical Engineers, Joy was made an OBE in 2011 for outstanding leadership and engineering management.

Mark Jones has joined WSP from Aecom as technical director for the Cambridge building services team. He has been in the industry for 19 years and has worked on a wide range of projects including residential, hotels, defence and commercial.

David Moulder has also joined WSP as technical director in the Manchester building services team. He has more than 20 years' experience as a building services engineer and has been a chartered engineer since 2002.

David Turner also has more than 20 years' experience in building services and has been appointed associate director by ChapmanBDSP. He will lead its public health group on a range of projects.

Building services engineers can help save the world

Fiona Cousins says engineers possess all the knowledge to tackle climate change

GUIGAAMARTINS / SHUTTERSTOCK

Building services engineers have the knowledge and the expertise to save civilisation, the audience at the latest CIBSE Annual Lecture were told.

Fiona Cousins, principal at Arup's New York office, urged CIBSE members to 'inhabit their role' and become 'poster children' for tackling climate change. Speaking at the Royal Society of Arts, in London, she said chartered engineers already possessed 'all the knowledge you need to do your job well'. However, she also urged the profession to improve its performance. 'There is no room for "just good enough" when tackling the greatest challenge in a generation,' she said.

'Engineering professionals will have to commit themselves to push for the highest possible standards, in themselves and others, when creating projects that work and are sustainable.'

Cousins said it was obvious that climate change was the greatest challenge facing this generation and the next, but added that we have 'never had more tools available to help us fight it'.

CIBSE President, Nick Mead, said Cousins' lecture was 'an inspirational shot in the arm for the industry, which reminds us of the potential we have as professionals, if we only grasp the opportunity that is there before us'. Her words were also 'extremely timely', according to vice-president Paddy Conaghan, because of growing concerns about the 'performance gap' in buildings, which was fuelling criticism of the industry.

He said engineers needed to influence the political process because many of the people making decisions about the built environment were 'poorly equipped' to do so.

'Anyone can come up with grand designs, but it takes an engineer to ensure that they work,' Cousins said.

Apprenticeship numbers reach six-year high – and industry pledges more

The number of apprentices employed in construction has reached its highest level since before the 2008 financial crash, according to the Construction Industry Training Board (CITB).

Recruitment of apprentices rose by 12% last year, to reach a six-year high, with 22,496 embarking on training programmes in 2014/2015. This is up from 19,973 in 2013/14.

New research from the government's Skills Funding Agency shows that eight in 10 managers see apprentices as an important part of growing their business.

The survey revealed that having the right people and skills was considered '10 times more important to business expansion' than access to finance, and that firms who employ apprentices are five times more likely to 'rapidly expand their businesses'.

Over 30,000 new apprentice jobs were pledged by employers during last month's National Apprenticeship Week – 7,000 more than last year's campaign.

Business Secretary, Sajid Javid, said that apprenticeships 'don't just offer life-changing opportunities to our young people, they also deliver for the bottom line'.

He added that the government was committed to creating 3 million apprenticeships by 2020 'because apprenticeships are good for Britain'.

Read more about apprenticeships on page 36.

Energy efficiency claims for equipment lack 'credibility'

- **Only 5% of those surveyed trust manufacturers' performance data**

Commercial buyers of building services equipment do not believe manufacturers' claims about energy savings, according to a survey carried out by the Carbon Trust.

One in three respondents told researchers there was a lack of 'credible information' about the energy efficiency of equipment and only 5% had any confidence in the performance data provided by manufacturers. They said this was a 'significant barrier' to their efforts to improve the performance of their built assets and their organisations as a whole.

Of the 135 organisations polled, two-thirds said they didn't calculate the whole-life costs of items such as heating systems, lighting and pumps. Almost half were unaware of the Energy Technology List (ETL) managed by the Carbon Trust, which details energy-saving equipment that qualifies for tax breaks through Enhanced Capital Allowances.

'Making good decisions depends on having good-quality, reliable information,' said Carbon Trust associate director Paul Huggins. 'In the past few months, the performance gap between manufacturers' claims and real-world performance has become a prominent issue.'

The ETL is part of the problem and is not achieving its aims of delivering energy efficiency, according to David Pepper, managing director of boiler and water heater manufacturer Lochinvar. He said it still relied on performance data produced 'under ideal laboratory conditions' designed to meet CE standards.

'Specifiers rely on this data, but it regularly produces results that may be a long way from what the system actually produces in the field,' said Pepper, who believes the Trust would be better off using data produced for the Ecodesign of Energy Related Products (ErP) directive.

'The ErP testing regime is far more rigorous than that used for CE marking, and much closer to actual performance criteria,' Pepper added.

Lloyds' £1bn green property fund

Lloyds Bank has launched a fund to help owners of commercial property improve their energy efficiency.

The £1bn fund will offer discounted loans to real estate companies that pass a benchmark carbon-reduction test. Lloyds claims the fund could help property owners save a total of 110,000 tonnes of carbon.

TOM GOWANLOCK / SHUTTERSTOCK

The better the property owner performs in the test, the better the discount they will be offered, up to 20 basis points below Lloyds' agreed rate on new loans of at least £10m. Typical loans from the fund are expected to be between £50m and £100m.

'More and more capital is coming from sovereign wealth funds, or pension funds, and they are under pressure to do more in an environmental sense,' said Lloyds' global head of commercial real estate, John Feeney. He added that this kind of funding would be best suited to refurbishment of 1980s buildings.

Government signs up to zero carbon emissions

The government has agreed to set a 'legally binding' zero emissions target, but it will not back down on planned cuts to renewable and energy efficiency subsidies.

Energy Minister Andrea Leadsom, said enshrining the Paris goal for net zero emissions in UK law was a priority for the current administration, but she said there would be no going back on its commitment to end subsidies for onshore wind power.

'Our actions have shown that we will be tough on subsidies to keep bills down for families and businesses,' Leadsom said.

She did not set a target date for reducing emissions to zero, but told the House of Commons that the question was 'not whether, but how we do it, and there is an important set of questions to be answered before we do'.

Last December, world leaders at the COP21 conference in Paris agreed to keep global temperatures 'well below 2°C' and Leadsom said this would require a more ambitious emissions target than the current 80% reduction by 2050.

However, Secretary of State for Energy and Climate Change Amber Rudd, said recently that keeping the temperature rise below 2°C was an 'aspirational' goal and not legally binding.

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Yorkshire's 'pride and passion' awards open

The CIBSE Yorkshire Awards will be held at the Royal Armouries, Leeds, on 18 November, replacing the former annual dinner. The evening's theme is 'pride and passion', and will focus not just on excellence, but also on those who inspire and enthuse others in the building services industry.

Now open for entries, the Yorkshire awards are aligned with the CIBSE Building Performance Awards (BPAs), with three identical categories. For those categories, you can enter the Yorkshire awards using the same entry, project and information as for the BPAs.

The awards will be presented for best practice, product innovation, inspirational training, project of the year and cooperative working, plus the traditional student awards. For a full list of categories and to enter visit **http://bit.ly/1Z0VmPv**

Cash and trophy up for grabs

Applications are open for the President's Prize 2016: The CIBSE Undergraduate Award.

Sponsored by Hays Building Services, the award is open to all final-year building services engineering (or related) BSc, BEng and MEng student members of CIBSE, in the UK or overseas.

Entrants must submit a 2,000-word synopsis of their final-year project, showing evidence of excellent understanding and knowledge of building services engineering, science and design, as well as originality and high-quality visual information.

The winner will receive £500 and a trophy, and two runners-up will each receive £100.

For more information and to download an application form, visit **www.cibse.org/awards** The closing date for entries is 22 July.

LSBU seeks healthier office

- **Green Infrastructure as a building service design challenge**

London South Bank University's (LSBU's) Clarence Centre for Enterprise and Innovation is challenging industry and academia to collaborate in developing ideas for how internal green infrastructure could make their offices healthier and more sustainable.

The challenge will be launched at a productive design thinking workshop at GreenSky Thinking – a week-long, London-wide events programme – on 25 April. This will include a building tour and briefing, rapid expert talks for inspiration, and facilitated development of ideas.

The LSBU has partnered with CIBSE and the Adaptation and Resilience in the Context of Change (ARCC) network to challenge conventional building services design. Interdisciplinary approaches are welcomed and the design challenge is open to all.

The interaction of indoor plants with heating, cooling, acoustic management, air quality, staff productivity and wellbeing is an exciting and growing area of research. The potential for these benefits to be combined to provide a building service is fundamental to the challenge.

All submissions must contain an overarching creative vision for the centre and detailed design of an element that could be piloted as an installation. The shortlisted designs will be presented on 29 April and exhibited to the public before the winner is announced.

CIBSE and the ARCC Network are part of a task group that facilitates leadership and knowledge on green infrastructure in a building services context. For more information and details of all GreenSky Thinking events, visit **www.greenskythinking.org.uk**

Consistent policies key to energy demand reduction in the UK

CIBSE has submitted evidence to the House of Commons Energy and Climate Change Committee, saying that: 'A lack of consistent policy-making and disjointed attempts at delivery are behind past failures of energy efficiency policy.'

Its submission concludes that the UK's lack of progress in the energy efficiency of its buildings is down to the lack of a long-term plan, and the failure to treat energy efficiency as a national infrastructure priority.

The response was given to the committee for its *Home efficiency and demand reduction* report. This echoed CIBSE's recommendations that efficiency be a key part of the government's energy policy, and that this be backed by a joined-up national strategy to provide a stable landscape for consumers and investors. Policies for energy efficiency currently vary across commercial, public, domestic and non-domestic buildings. The picture becomes even more muddled on a national level, where schemes vary by location, scale and form – with some requiring loans and some being funded based on local demographics.

These problems, combined with a history of under-resourcing of schemes and patchy support, make it hard to attract businesses and consumers to the economic case for energy efficiency.

Sara Kassam, head of sustainability at CIBSE, said: 'In their current form, energy policies, nationally, are hampering efforts to reduce energy demand by seeking to make buildings more efficient through a combination of poor direction and a lack of commitment to funding and deployment.

'By giving energy efficiency the national attention and funding it deserves, we can tackle the UK's carbon emissions and alleviate pressure on other areas – including fuel poverty and energy security – by reducing the need for power.'

Young engineers can shine as 2016 award opens for entries

Event on 13 October will be held at the Institution of Mechanical Engineers (IMechE) in London

The CIBSE Young Engineers Awards 2016 are open for entries.

The accolades celebrate the industry's best young engineering talent, as well as employers' strategies for recruiting, nurturing and empowering young people.

Comprising the Graduate of the Year and Employer of the Year prizes, the awards scheme is sponsored by Andrews Water Heaters, Ruskin Air Management and Waterloo Air Products. It is supported by the CIBSE Patrons and organised by the CIBSE ASHRAE Group, in conjunction with the CIBSE Young Engineers' Network.

The Graduate Award – jointly presented by CIBSE and ASHRAE – celebrated its 20th anniversary last year. It has long been the most sought-after accolade for young building services engineers, and this year's winner will enjoy an all-expenses-paid trip to the ASHRAE Winter Conference in Las Vegas next January.

The two runners-up will receive cash bursaries from The Rumford Club, and all other finalists will receive £100 from The Manly Trust.

Any engineer who has graduated in a building services-related field – at either undergraduate or postgraduate level – in the past two years is eligible to take part.

The Employer Award has three categories giving small, medium and large employers the opportunity to demonstrate how they place young engineers at the centre of their business, and invest in their career progression.

The judges will be looking for evidence of innovative methods of engaging and motivating young engineers, and encouraging them to fulfil their potential for the long-term benefit of themselves, their employers and the industry's clients.

The judging panel includes the CIBSE, ASHRAE and IMechE presidents, along with the current graduate of the year, Ryan Rodrigues, and The Rumford Club chair.

To enter the CIBSE Young Engineers' Awards visit **www.cibse.org/yea** and for more information email **yea@cibse.org**

Last year's Graduate of the Year Ryan Rodrigues (third from left) with the other finalists

Cast your vote in CIBSE elections

The ballot to elect officers and board members is now open and eligible members should have received details of the voting procedure.

All corporate members – Fellows, Members, Associates and Licentiates – are entitled to vote. If eligible, you should have received an email from Electoral Reform Services (ERS) with a unique link to the ballot website. Where no email address was available, a letter has been sent. A reminder email, including the unique link, will be sent on 14 April to those who have not voted by that date.

Candidate information is available on the ballot and the CIBSE websites.

If you are eligible to vote but have not received an email or letter, contact the ERS on 020 8889 9203 or **customerservices@electoralreform.co.uk**

The voting deadline is 22 April.

The board has a vital role in ensuring CIBSE has a successful and vibrant future, so please take the opportunity to have your say in the selection of its members. More information about the election and candidate information is available at **http://bit.ly/1R3fFq8**

In brief

SYMPOSIUM FINAL CALL

Time is running out to register for the sixth annual CIBSE Technical Symposium, which will be held at Heriot-Watt University, Edinburgh, from 14-15 April. The programme for this year's event – sponsored by Rinnai, Sefaira and Cadline – is available at **cibse.org/symposium**, and includes 50-plus reviewed papers.

This year's theme is 'Integration for whole-life building performance'. Register at **www.cibse.org/symposium**

GOVERNANCE REVIEW

Last May, Members were invited to submit their views about aspects of the Institution's governance, before a review of existing arrangements commissioned by the Board.

This review has been completed and the report, plus recommendations, were presented to the Board at the beginning of the year. A task force, led by the President, is being established to propose an implementation process.

Details of this review and the next steps will be given in the May edition of *CIBSE Journal* and on the website.

AGM DATE CONFIRMED

The CIBSE AGM will be held on 5 May at The Royal Society, 6-9 Carlton House Terrace, London, SW1Y 5AG. It will be followed by incoming president John Field's address. Members will receive a calling notice this month. Further details at **www.cibse.org/agm**

Letters

This month, how to reduce the risk and effects of flooding, and why Brexit could be detrimental to a construction industry that has to plug the skills gap using workers from overseas

Keeping floods at bay

Flood prevention mechanisms and systems have been in place around the UK for several years, so the immediate explanation for damaging winter floods might be that these defences are no longer adequate to support the increasing sea levels and rainwater. Long-term flood-prevention measures, integrated into the UK's infrastructure, are needed to cope with future rainfall problems.

Floodwater not only causes severe property damage, but it also poses a risk to public health because it penetrates earth and sewers, which carry dirt and bacteria. Pathogenic viruses could be swept up in the water, and these may survive even after water levels have subsided.

One way to prevent the flow of water – while reducing the risk of contamination – is through sustainable urban drainage systems (SuDS), which are starting to be widely introduced in new developments. SuDS look to maintain the quality of run-off water while reducing the quantity. Examples include green roofs, permeable paving, bio-retention systems, balancing ponds and storage tanks.

Along with structural flood-prevention measures, it is also important to look towards natural source controls as a way of reducing the amount of rainwater that runs towards urban areas. Floodwater flowing down to lower-lying catchment areas is mostly derived from higher-up river systems, and from smaller tributaries and brooks.

Potential natural flood-management techniques include natural dams, which slow the flow and spread water over a greater area. In addition, overland flow barriers can disconnect flow pathways to store floodwater temporarily, reducing the volume that ends up in towns and cities, where drainage capabilities can be limited. This technique has proven particularly successful in the Stroud valley, in Gloucestershire, recently, when water flow towards the town of Stroud was reduced.

Long-term flood defence needs to combat future rainfall

AC RIDER / SHUTTERSTOCK

A combination of the Environmental Agency, local authorities and other stakeholders, must ensure that these natural measures are enforced and implemented. Their integration into the country's built environment, alongside SuDS, will result in cleaner and more manageable water levels in downstream urban areas.

Shaun Pentlow,
associate director at Rolton Group

Brexit is not the solution

The big issue we face is that we haven't trained our workforce – from professional services through to construction management and trades – for about 20 years.

I was the last generation to benefit from a wide adoption of good training plans within organisations, before the recession in the early 1990s. Since then, our skills shortage has been filled by migrant labour. Without this, many of the projects that facilitate other activities to enable our economy to grow wouldn't have been built.

> It has taken a generation for us to get to where we are now, and it will take another generation to get us out of the problems we have created

The UK construction industry has long relied on foreign workers to fill skilled and non-skilled roles. In the 1950s, Irish workers were driven from their country because of financial problems, and made up the backbone of our construction labour force from the 1960s to the 1980s. Now, that workforce comes from nations such as Poland, the Czech Republic and the Balkan states.

If we exit the EU – which has the right of free movement – it is likely that construction workers would head to France, Germany or Spain, creating further labour shortages.

A skills crisis cannot be solved by a politician waving a magic wand, or by throwing some money at it. It has taken a generation for us to get to where we are now, and it will take another generation to get us out of the problems we have created. The coalition government made a good start by promoting apprenticeships and science, technology, engineering and maths (STEM) subjects in the classroom, prompting the beginnings of a recovery.

We now find a fairly high proportion of our middle managers coming from overseas to fill the gap; and our young people are mentored by managers from inside and outside the EU. So, if migration into the UK is cut off, growth in our businesses will stall because there will be a lack of middle managers to run projects and mentor apprentices.

We are already suffering from skills shortages in the UK construction industry. An 'out vote' – aside from destroying European unity – would only exacerbate this.

Steve Hale,
director at Crofton Design

CIBSE Journal welcomes readers' letters, opinions, news stories, events listings, and proposals for articles.
Please send all material for possible publication to: editor@cibsejournal.com or write to: Alex Smith, editor, *CIBSE Journal*, CPL, 1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PB, UK. We reserve the right to edit all letters.

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WHAT THE BUDGET MEANS FOR BUILDING SERVICES

The Chancellor's 2016 budget covered other measures besides welfare. **Hywel Davies** reviews the announcement for those aspects that may be of interest to building services

The full budget document is a weighty tome, running to more than 140 pages[1]. But tucked away in the detail are several areas of serious interest to *CIBSE Journal* readers.

The major one is paragraph 3.322, 'Digital standards in construction'. It says 'the government will develop the next digital standard for the construction sector – Building Information Modelling 3 – to save owners of built assets billions of pounds a year in unnecessary costs, and maintain the UK's global leadership in digital construction'. The basic premise is to deliver the enabling standards set out in Digital Built Britain[2], the government strategy for Level 3 Building Information Modelling (BIM), in a £15m programme of work, which is still being worked out.

However, the announcement of this initiative to develop Level 3 BIM should not have a significant impact on completion of the Level 2 programme, which comes into force for central government procurers as you read this.

Some of the opportunities identified in the Level 3 strategy include:

- creating international, 'open data' standards to enable easy sharing
- establishing a new contractual framework for projects procured using BIM, to ensure consistency and to encourage collaborative working
- creating a cooperative, sharing and learning cultural environment across the market
- training public sector clients to use BIM to support their data requirements, operational methods and contractual processes
- driving domestic and international growth and jobs in technology and construction.

BIM Level 3 will require changes in supply-chain working patterns, and will have implications around ownership of the BIM model in various scenarios. While, long term, BIM may contribute to reducing the costs of the government estate and infrastructure assets, coordination and learning costs will accompany its introduction.

SHAUN JEFFERS / SHUTTERSTOCK

Upwardly mobile Liverpool: Devolved regions could allow more tall buildings to be built under plans revealed in the budget

> We will need to pay close attention as the 'digital strategy' unfolds

The 'digital strategy' is the key means by which the government intends to drive reform of the construction sector, so we will need to pay close attention as it unfolds. It would be good to see the Level 3 programme learning from the experiences of Level 2, and seeking to engage all the key players in a collaborative approach from the outset.

The budget also included the widely expected demise of the Carbon Reduction Commitment (CRC), after last year's consultation on simplification of the business energy efficiency tax landscape. Paragraph 2.170 announces its abolition from the end of the 2018-19 compliance year, with a final surrender of allowances in October 2019.

The main rates of the Climate Change Levy (CCL) will increase from 1 April 2019, to cover the shortfall from CRC and to 'incentivise energy efficiency in CCL-paying businesses'. In the meantime, the main rates for CCL and for CRC allowance prices will rise in line with the retail price index (RPI).

The CCL discount for sectors with Climate Change Agreements (CCAs) will be reduced to compensate for the CCL increase – from 90% to 93% for electricity, and from 65% to 78% for gas, from 1 April 2019. The eligibility criteria for CCAs will remain until at least 2023, with a target review to include the buy-out price for periods 3 and 4 starting in 2016. The main rates of CCL for different fuel types will be rebalanced to reflect recent data on the fuel mix used in electricity generation, with a long term aim 'to reach a 1:1 ratio of gas and electricity rates by 2025'. CCL exemptions for renewable energy will end from 31 March 2018.

There is a commitment to consult later in 2016 on a simplified energy and carbon reporting framework, for introduction by April 2019. This is significant because the next round of ESOS reporting is due to be completed in December 2019.

Finally, in the section on housing and planning, paragraph 2.289 says that 'following the consultation on building up in London and to help increase densities on brownfield land and reduce the need to 'build out', the government will consult with city regions on extending similar powers as part of devolution deals'. We may be looking at more high-rise developments outside of London, so may need to develop knowledge and skills to deliver tall buildings more widely.

Building higher poses specific building services challenges because of the effect of gravity and increasing pressures. CIBSE currently has limited guidance on this aspect of building; is it time we developed some more? Email your thoughts to **technical@cibse.org**

References:

1 See **http://bit.ly/1S5S8Fc**

2 See **http://bit.ly/1RxVZKv**

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

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MAKE PROCUREMENT WORK WITH PASSIVHAUS

Design and build offers the potential for an integrated design approach – essential when designing to the Passivhaus standard. But there are instances when the procurement route can lead to uncoordinated designs and costly delays. Architype's **Elrond Burrell** highlights the pitfalls

Design and build procurement is popular in the UK for large-scale Passivhaus projects. Clients – often public bodies – want the benefits of Passivhaus, but are wary of the delivery risks in a relatively immature market.

A design and build contract allows the client to pass the majority of the risk to the contractor and offers the potential for an integrated design approach. This is beneficial for a Passivhaus project and, when done right, the full design and construction team can collaborate to develop a highly integrated solution that happily marries aesthetics and functionality with exceptional building performance. When done wrong, however, the procurement route won't result in an integrated design approach. There are two situations where design and build can conflict with Passivhaus:

1. Design scope mismatch

At the pre-tender stage, the architect, typically, has a greater design scope than the building services engineer.

The architect will aim to design the building in as much detail as is practical to ensure the client brief can be achieved, and is protected in the tender design. A comprehensively detailed Passivhaus tender package will give certainty and reduce tender risk. On the other hand, the engineers will most probably only be developing key building services strategies, performance criteria and schematics. This can be a considerable mismatch with the level of detail the architect develops.

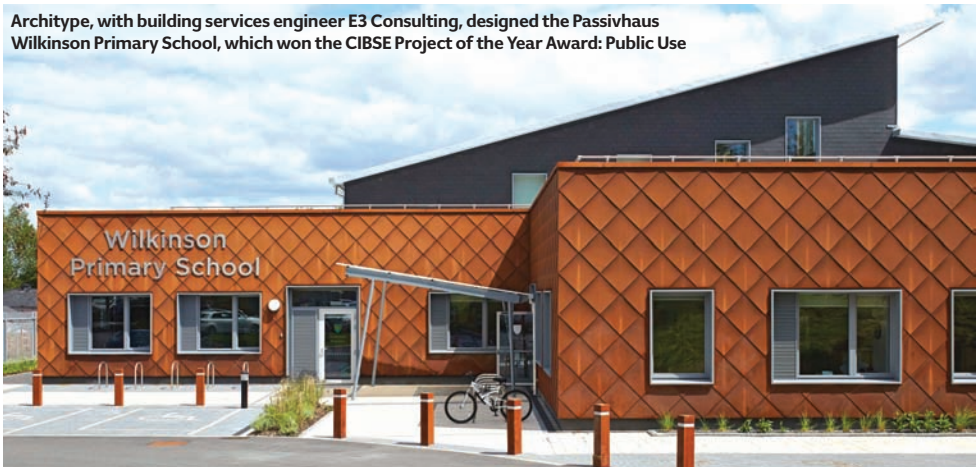
This mismatch makes it difficult for the architect to accommodate the building services and coordinate the design. Plant space, duct sizes, and pipe and cable penetrations will only be approximate and remain at risk until a fully detailed building services design is complete. Additionally, the Passivhaus Planning Package (PHPP) model will be missing important elements, or will need to contain conservative assumptions to be useful.

The PHPP will only provide a limited reflection of the suitability of the design to achieve the Passivhaus standard. The building services design is then developed in detail by the post-tender engineers or subcontractors. Because the architecture is already designed in much greater detail, but not coordinated with the building services (or structures), this often leads to late – and potentially expensive and risky – design changes.

It is more cost effective when all the consultants work to the same design scope. A coordinated integrated design can be developed to the appropriate level of detail at each stage, and the PHPP can be a detailed and useful model at each stage.

2. Tender design overconstrained

This is sometimes a consequence of the previous scope mismatch, leading to an uncoordinated Passivhaus tender design gaining planning consent.



Architype, with building services engineer E3 Consulting, designed the Passivhaus Wilkinson Primary School, which won the CIBSE Project of the Year Award: Public Use

> Award-winning, beautiful Passivhaus architecture can be delivered successfully, and cost effectively, through design and build

It also happens when the pre-tender design team does not include anyone with suitable experience of successful Passivhaus design and delivery.

Attempting to shoehorn Passivhaus into a project late in the design process also leads to this unfortunate situation.

All these scenarios result in the architecture being overconstrained by the level of detail that is already fixed. Often, the external visual appearance, material choices and dimensions are fixed, despite not necessarily being suitable for Passivhaus. Integrated cost-effective and low-risk solutions become virtually impossible.

Award-winning, beautiful Passivhaus architecture can be delivered successfully – and cost effectively – through design and build. This is achieved by aligning the scope of design consultants and including competent, experienced Passivhaus designers in the team from the beginning.

● Read about the Passivhaus Wilkinson Primary School in our education special

● **ELROND BURRELL** is an architect, certified Passivhaus designer and an associate at Architype. Read his blog *Passivhaus in Plain English & More* at **http://elrondburrell.com**

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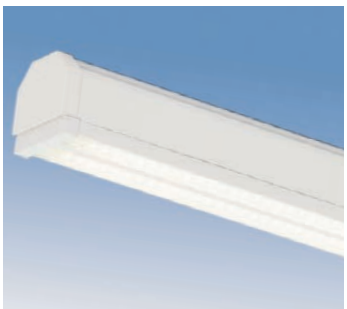

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ENOUGH IS ENOUGH

This year's Ecobuild conference had plenty to inspire delegates – from electric vehicles powering homes to 3D printing on Mars – but the most important debates were over building performance and how the industry could organise itself to improve its buildings

> Design for performance requires a deep culture change in the UK and Europe
> *Robert Cohen*

One of the star attractions at the 2016 Ecobuild conference was, literally, out of this world. Foster + Partners showed how lunar modules could be built on the moon using robots parachuted onto the surface.

Partner Xavier De Kestelier said 3D structures could be constructed on the moon and Mars using loose rocks and soil. He told the audience that Foster + Partners envision a 93m^2 martian base constructed, layer by layer, from regolith – the mix of soil and loose rock found on the surface of the Red Planet.

The fused regolith creates a permanent shield, with a bird-bone-like structure, protecting the settlement from excessive radiation and extreme outside temperatures, that fall to -125°C.

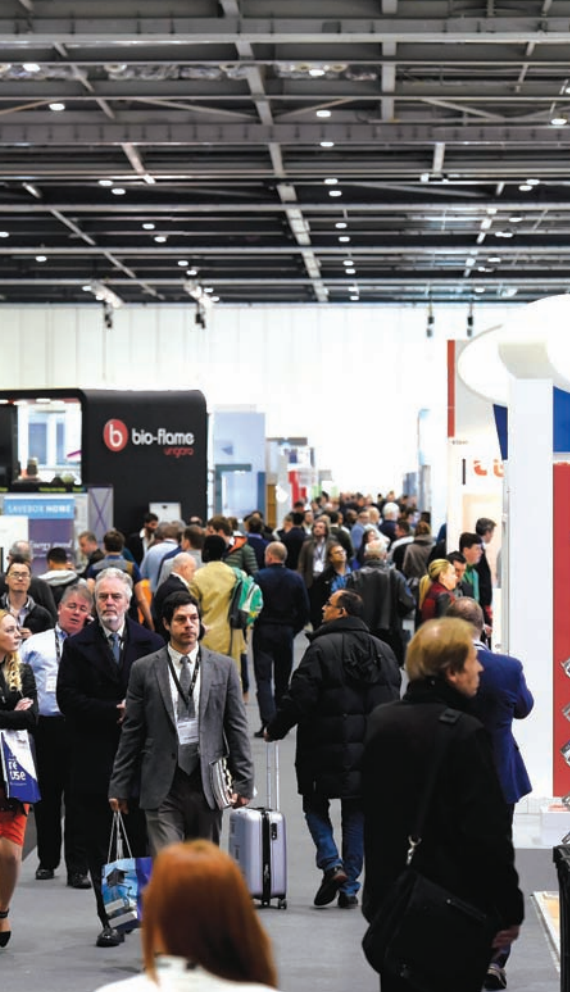
De Kestelier said: 'The vision is that we will have one million people on Mars in the next century. These are techniques and materials we are testing now – it is reality.'

While the Mars project fired the imagination of Ecobuild delegates, other presentations reminded them that there is still plenty of work to do to improve building stock on planet Earth. In the wake of the poor results from the Building Performance Evaluation (BPE) programme (see page 27), many speakers lamented the performance of UK building stock.

In a seminar hosted by the Better Buildings Partnership, new research presented by Verco technical director, Robert Cohen, mirrored the BPE results. It found that commercial buildings in London were using two to four times more energy than equivalent offices in Melbourne.

Special guests Stephen Fry and Will Gompertz, BBC arts editor

Cohen described how the Nabers mandatory energy rating scheme had improved the performance of commercial buildings in Australia. He said the UK and Europe could not adopt the same system because they lacked the essential requirements of Nabers, such as: a definition of a base building; an investment-grade measurement standard; a



HS2 design lead Sadie Morgan addresses the conference

consumer rating system; or a requirement to disclose performance on sale or let. 'Design for performance requires a deep culture change in the UK and Europe,' Cohen said.

Chris Tinker, executive board director and regeneration chairman at Crest Nicholson Regeneration, recalled systems that had not worked properly on their schemes. 'The reality is that delivering low carbon energy has unintended consequences,' he said.

Tinker described how, on one scheme, residents ran the system on full and opened windows when it got too hot. 'The system is designed for low energy, but consumes more energy because of how we behave, not because of how they are delivered.'

Arup associate director Barry Austin highlighted the unmanageable complexity of some buildings, with controls fighting each other to cool and heat buildings.

'In every problem building we go into, controls are the issue,' he said. 'It's a case of going through them systematically, but it can make huge improvements.'

Austin added that use-of-building data would help create feedback, but intuitive interfaces had to be designed for people running buildings. It was, 'a nut that the industry had yet to crack', he said.

Jon Bootland, Passivhaus Trust CEO, said the performance gap is an issue not just with energy, but also for environmental and thermal comfort.

He believes the main driver to change the housing model is the forecast increase in heat-related deaths because of climate change and an ageing population – from 2,000 to 7,000 per year by the 2050s. (See panel 'Why overheating is a hot topic').

Bootland said retrofit works to solve such problems could cost between £17,000 and £30,000 per dwelling.

A session on the Bonfield Review suggested a system of standards and enforcement for the retrofitting of housing would be recommended to government by the summer. The review is expected to play a key role in informing green housing policy that would overhaul the UK's existing housing stock.

Review chair and BRE chief executive, Peter Bonfield, said they wanted to create standards and an enforcement regime that would 'build trust and confidence in the way energy efficiency measures and renewables are put in place.' (See panel, 'Every Home Matters').

There were plenty of encouraging signs of organisations getting to grips with building performance at Ecobuild.

Delegates at a session on the Mayor of London's RE:FIT energy efficient initiative heard that, since 2009, £93m had been saved across 607 buildings.

The programme guarantees cost savings of around 28% for public sector organisations, thanks to an energy performance contract framework for

Delegates applaud a speaker at Ecobuild

Every Home Matters

A presentation on the recommendations of the upcoming Bonfield review, officially known as *Every Home Matters*, gave an insight into the standards and guidance that government might implement to improve the energy performance of existing homes.

Liz Male, who chaired a skills and training stream, said there needed to be a holistic approach to low energy homes and said an 'underpinning knowledge and understanding of basic building physics' was required. There was a knowledge gap in assessment, design, installation and supervision of low-energy homes, she added, and a training and accreditation system would be put in place to ensure consumers could choose from a list of competent certified companies. The review will also recommend a certification system for products, and a Code of Practice for firms.

Bonfield said the new system would establish one place for consumers to find out more about their home. 'Enough is enough,' he said. 'We're going to take responsibility for delivering measures we will be proud of in the future.'

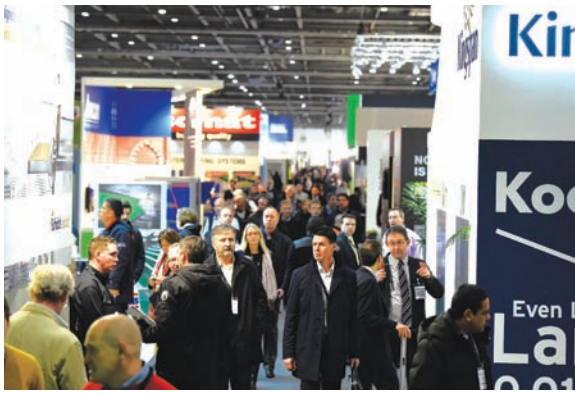
> The reality is that delivering low carbon energy has unintended consequences
> *Chris Tinker*

suppliers. A programme delivery unit ensures support throughout the lifetime of a project, including the leveraging of funding. The scheme is now being rolled out across the UK. 'There's a lot of money out there to help you pursue energy efficiency,' says Richard McWilliams, director at Turner & Townsend, the programme's delivery unit manager.

Accurate operational data is essential to verify the savings being made. 'If EsCOs [energy service companies] don't achieve those savings, they have to offer a refund, or put in measures at their cost,' said McWilliams.

An excellent case study for which data monitoring was key is the Crown Estate's 7 Air Street office development in the West End.

Jane Wakiwaka, sustainability manager at the Crown Estate, said: 'We pay for soft landings as we believe it's necessary to ensure the building functions properly, and the occupiers remain happy.' The £7,000 savings per floor, compared to a building that just complies with regulations, has helped ensure the Air Street office has been



92% let since its completion in October, said Wakiwaka.

An Edge debate, chaired by former chief construction adviser to the government, Paul Morrell, heard thoughts from various industry representatives on how the performance gap could be closed.

Alan Penn, dean of The Bartlett faculty of the built environment at University College London, said there should be a move to track performance and this could be incorporated into Building Regulations. 'If firms had failed previously, this would impact on whether their future projects would meet regulations,' he said.

Lynne Ceeney, project manager at UKGBC, suggested industry should aim towards ISO process standards rather than energy targets. The panel concluded that a Nabers-style ratings scheme should be considered in the UK. Wilmott Dixon's technical director, David Adams, said the contractor could work with performance targets. 'I'm keen. If you want outcome performance, ask for it. We have an industry to turn around and, in my opinion, the way to do it is to focus on outcomes.' **CJ**

Why overheating is a hot topic

Speakers in a session on overheating cited many examples of problem housing.

Paul Ciniglio, sustainability and asset strategist at First Wessex Housing Association, said that as many as 20% of new homes in the UK are suffering from overheating and uncomfortable temperatures.

He said the company had spent £50,000 on insulating heating pipework to try to combat overheating problems in two blocks of flats. 'That should have been right at the design stage – it's too late once the homes are built.'

'We cannot adapt to changing temperatures very quickly, so it's a bigger issue for us than for people in the Mediterranean.'

Nicola O'Connor, from the Zero Carbon Hub, said she never once thought to complain to the landlord when her London flat was overheating. 'It's this mindset we need to tackle; overheating is a problem that's as important as a broken boiler.'

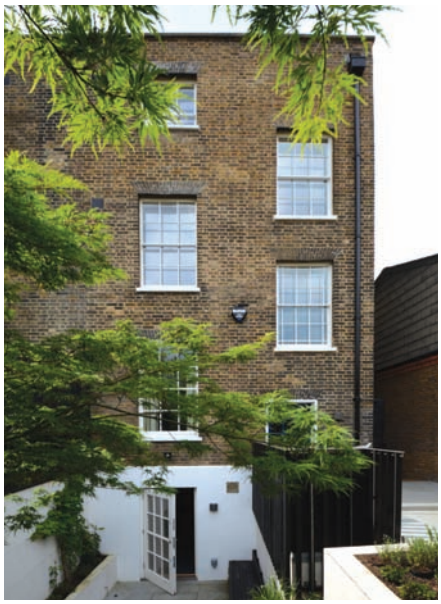
The Zero Carbon Hub found that 20% of dwellings are overheating – so the vast majority of buildings are not. 'But as the climate changes – and as we continue to build in dense cities – this problem is going to grow,' O'Connor said.

Nick Grant, principal of Elemental Solutions, said, as UK residents, 'we are not programmed to think that it's ever going to get hot'.

Tom McNeil, an engineer at Max Fordham, said: 'If your modelling assumptions are unrealistic, your results will be unreliable, but there is no industry standard on modelling inputs for heat gains from lighting, occupancy and equipment.'

FITNESS FANATICS

Arboreal Architecture was awarded Residential Project of the Year at the CIBSE Awards for its forensic approach to a domestic retrofit in Clapham. **Andy Pearson** looks at how a deep understanding of building physics enabled the design team to maximise performance



When it was bought in January 2012, the 170-year old, semi-detached, Grade II listed townhouse, in a conservation area in south-west London, was far from being an exemplar of low-energy living.

The four-storey, early Victorian home was beset by draughty, single-glazed sash windows, while its dilapidated fibre-cement roof leaked water. Inside, there were issues with rotten joists and floorboards, and uninsulated, damp, solid brick walls.

Four years later, and the house has been transformed. Arboreal Architecture has turned retrofit into a science with its refurbishment, and converted this unpromising Clapham home into the first listed building in England to meet the Association of Environment Conscious Building's (AECB) Silver Standard for its low-energy use. This achievement was recognised at the CIBSE Building Performance Awards, where the scheme won Residential Project of the Year. The judges described it as 'groundbreaking' and said the entry 'provided evidence of a mind-blowing set of work, really cutting-edge'.

The building's new owners were two eminent scientists relocating from Scotland to London. They set Arboreal Architecture the task of refurbishing the property to make it future-proof. The architect's response was to adopt a highly analytical approach, which no doubt was appreciated by its academic clients.

The architect's ambition for the retrofit was for it to meet the Passivhaus EnerPHit standard for refurbished buildings. To assess the scale of the task, it modelled the original house using the Passivhaus Planning Package (PHPP) tool and Passivhaus methodology. Its heat demand was 180kWh·m^{-2} per year for the 170m^2 of treated floor area, far in excess of the 25kWh·m^{-2} per year maximum allowed under EnerPHit. Meeting the standard was made more challenging because the building's listed status prohibited external insulation or the replacement of the single glazed, vertical-sliding sash windows.

'We wondered if we could achieve EnerPHit levels of heat demand, though we soon realised that the ductwork required for mechanical ventilation with heat recovery (MVHR) would have been too invasive, and would have compromised the historic detailing,' says Harry Paticas, director of Arboreal Architecture, who, instead,

CIBSE BUILDING PERFORMANCE AWARDS 2016

WINNER

Entries for the CIBSE Building Performance Awards 2017 open on Monday 9 May. The deadline for entries is Thursday 15 September. Visit **www.cibse.org/bpa**

decided to target the AECB Silver Standard. This is based on Passivhaus principles and methodologies, but sets a lower space heat demand of 40kWh·m^{-2} per year using PHPP. Even achieving this lower target, however, meant lopping 78% off the building's demand for heat. Undaunted, Paticas says: 'It seemed to be an appropriate standard to try to achieve'.

Arboreal's systematic approach to achieving AECB Silver was evident from the outset. The team looked at best practice; they contacted the Society for the Protection of Ancient Buildings and spoke to Historic England. 'To improve the thermal performance, we had to understand what we were dealing with before we started developing the design,' says Paticas.

The survey revealed jobs that would have to be tackled. These included: the repair of a leaky rainwater downpipe, which had soaked the external wall and caused some of the joists and floorboards to rot; removal, from the base of the perimeter wall, of the sand-and-cement render that was preventing moisture permeation from the basement walls; and repointing of the external walls to a depth of 25mm using lime mortar (see images). 'Some of what we were doing was just basic fabric improvements by reverting back to the original materials,' explains Paticas.

Arboreal employed building performance consultant Archimetrics to analyse the building. It carried out U value monitoring, an airtightness test and thermographic survey, and monitored interstitial temperatures and moisture gradients in the external walls. Crucially, the U value of the external walls was found to be 0.88W·m^{-2}·K^{-1}, significantly lower than 1.14W·m^{-2}·K^{-1} calculated figure – which meant less insulation would be needed to the walls to meet the AECB target.

The airtightness test demonstrated significant leakage in certain areas, such as the sash windows, shutter boxes and loft hatch. The measured building air change rate at 50Pa was calculated at 9.6 air changes per hour (ach, h^{-1}). The absorptivity (of rainwater) of the bricks and mortar joints was also assessed using Karsten cups on the outside walls. 'Unusually, we did a lot of pre-design investigations,' says Paticas.

Archimetrics and Arboreal even turned on the heating and used a thermographic camera to plot the radiator pipework routes beneath the floorboards and locate the notches in the joists, so the new heating system could reuse these where appropriate.

Armed with its detailed understanding of the building, Arboreal set about developing a sensitive restoration scheme that would retain the original features while upgrading its services and replacing the non-original kitchen and bathroom fittings. 'It is Grade II listed and in a conservation area, so it was never going to be a "design rich" project with extensive remodelling or an extension,' Paticas explains. Listed building consent for the refurbishment was granted in December 2012 and works started two months later.

INSULATION SPECIFICATION: RANGE OF FACTORS CONSIDERED

- Hygrothermal condition of existing building fabric
- Historic significance, character and special interest
- Local climate conditions
- Existing wall build up and available thickness for insulation
- Thermal performance (lamda and resultant U value)
- Vapour permeability
- Hygroscopicity and moisture buffering
- Capillarity
- Buildability, storage and material processes
- Fire rating
- Reversibility
- Cost
- Compatibility with thermal bridging, airtightness and ventilation strategies
- Embodied energy and global warming potential

INSULATION MOISTURE-RELATED FACTORS

- Existing building fabric – maintenance and condition
- Local (micro) climate conditions and orientation – consider driving rain and solar radiation
- Existing wall build up – such as presence of cementitious materials, thickness of brick, absorptivity
- Ventilation strategies – management of internal humidity
- Thermal performance (lamda and resultant U value) – through testing and calculation
- Vapour permeability (miu and sd values) – often measured as the resistance to vapour transport
- Hygroscopicity and moisture buffering – sorption and desorption of water vapour
- Capillarity – sorption and desorption of liquid water
- Compatibility with thermal bridging – adjacent uninsulated elements will have higher heat loss

Concrete mortar was removed and the brickwork repointed using lime mortar (bottom)

A major challenge was to add a significant amount of fabric insulation while ensuring the building remained 'moisture robust' and without resulting in future damage to the building. 'You need extensive experience to understand what you're doing with a retrofit, because there can be unintended consequences of adding too much – or the wrong type – of insulation,' warns Paticas.

In response, the architect used 12 types of insulation – including wood fibre, aerogel and cellulose – and a decision on the most appropriate solution was based on several factors (see Figure 1 and panel 'Insulation specification: range of factors considered').

'We chose insulation bespoke to the location to optimise its performance,' says Paticas. In the loft, for example, blown cellulose insulation was used between various timbers criss-crossing the space. 'The cellulose is hydroscopic, so absorbs moisture in winter and dries out (desorps) in summer'.

In the basement, the screed was removed from the retained concrete floor so thin vacuum-insulated panels could be laid over the slab; these were then covered with new, lightweight insulating screed, with minimal impact on the finished floor level. In this way, a cheaper, high-performance solution was found without the disruption of breaking out and disposing of the concrete.

Different types and thicknesses of insulation were used for the façades depending on the factors that the insulation had to address (see panel, 'Schedule of insulation'). The front of the house faces west, the exposed side wall north, and the party wall south. These are stock brick, solid, and vary in thickness from 492mm (two bricks) on the lower-ground floor to 330mm (1.5 bricks) on the ground and first floors, and 225mm (one brick) on the second floor. In some areas, 10mm, 20mm or 30mm aerogel-backed magnesium silicate boards have been applied, depending on factors specific to that location. In other areas, wood fibre has been used. 'We wanted vapour-permeable construction to allow the building to work as it always has – which is to dry both inwards and outwards.'

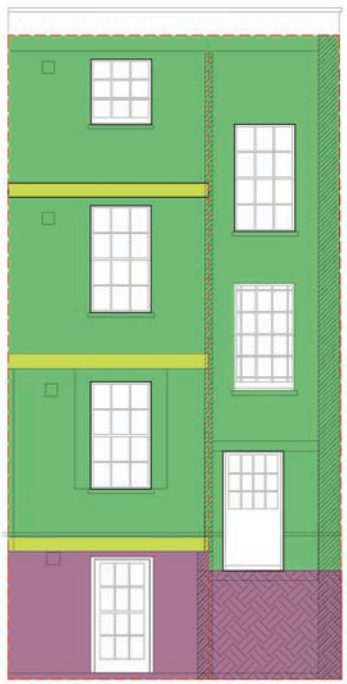
As well as being thermally efficient and vapour permeable, the fabric had to be airtight. The primary air barrier was formed by new lime plaster being applied to all internal masonry walls. Air leakage was minimised by a taped Intello Plus membrane on the ceiling, dressed into the walls with plaster sealing tape. In addition, joist ends – and junctions with doors and window frames – were sealed with tapes and service penetrations with EPDM rubber grommets.

Double-glazed secondary glazing units were fitted inside the original sash windows, carefully designed so the sight lines matched.

Once the airtightness works had been completed, the building was pressure tested again. This time, it achieved an impressive 1.8ach at 50Pa. With co-pressurisation of the neighbour's house to eliminate leakage through the party wall, this was 0.3ach. 'With an air leakage rate of less than 2ach at 50Pa you need continuous mechanical extract ventilation,' says Alan Clarke, a Passivhaus specialist and the project's building services engineer. Decentralised continuous extract ventilation is used with an extract fan mounted in each of the three bathrooms and the kitchen. To minimise their visual impact, the fans are concealed in existing external vent grilles. Together, they deliver 0.4ach. Trickle vents in the bedroom windows supply make-up air, with additional air drawn into the house through natural leakage in the fabric.

Figure 1

Proposed front elevation
Scale 1:100



Proposed back elevation
Scale 1:100

Insulation key

- Thermal bridge (+VE OR -VE)
- Styroform insulation below ground
- Cellulose
- Vacuum insulated panel
- Wood fibre
- Pir or rigid thermoset
- Aerogel
- Iqtherm
- Calsitherm
- Perlite beads
- 30mm Aerogel + 150mm wood fibre
- Rockwool
- Thermal bridges

Types of insulation used on different areas of the building's façades

Karsten cups measured the absorptivity of the bricks and mortar

A leaky downpipe had soaked the brickwork

Hot water for the kitchen and bathrooms is generated by 3m² of roof-mounted, south-facing solar thermal collectors and a 12kW condensing boiler, both of which are connected to an unvented solar hot water cylinder. A manifold enables the domestic hot water to be distributed via a radial microbore pipe system, using 10mm pipes to deliver hot water directly to the taps via the shortest route. This solution helps minimise the amount of water contained in the pipe dead-leg and heat gains from the hot water pipework.

The 12kW condensing boiler also provides heat for the low temperature hot water heating system. Stelrad's Radical radiators were used for their higher radiant output, which allows for lower system flow and return temperatures. The boiler is controlled using room compensation to minimise the overheating risk by adjusting the boiler temperatures to room conditions.

When, in November 2013, the owners moved in, Arboreal asked them to record how much energy was generated by the three solar thermal panels – and it was found they were producing about 30% of the energy they should have been. This was because a temperature sensor in the solar hot water kit was not working properly. The boiler had also been incorrectly set to come on after the occupiers showered each morning, filling the water cylinder with heated water so it had no capacity to store the solar thermal heat. The issues were remedied and the panels' output is now as predicted.

As part of the monitoring of conditions in the house, 22 wireless remote sensors have been installed in various locations, three of which record ambient temperature and humidity. These ambient sensors showed that, initially, relative humidity (RH) was higher than predicted. This was easily rectified once it was found that the mechanical extract ventilation had been set to an extract rate of 6l·s⁻¹ rather than to the 9 l·s⁻¹ design rate. Since the adjustment, internal temperatures have remained steady, at 20°C, and internal RH has stayed within the 50-60% bracket. 'We found relative humidity was a lot better than in a standard Victorian house,' says Clarke.

The remaining 19 sensors were installed in the walls before the fitting of the insulation and the replastering. Each sensor is screwed into a piece of timber sawn from the rotten joists that had to be replaced. The newly applied insulation means the walls are colder than they were, so the sensors monitor temperature, RH and wood moisture equivalent in the walls, so the team can understand the conditions experienced by the timber joist-ends and lintels set into the walls. There has been a general downward trend in the wall's moisture content over time.

According to Paticas, the occupants find the internal conditions very comfortable. Equally importantly, the architect's investigative and methodical approach have proven worthwhile: 'The thermal modelling we did told us we'd get a heat demand of 40kWh·m⁻² per year – and we have,' says Paticas. 'We've succeeded in closing the performance gap.' Quite impressive for a 170-year old house. **CJ**

> Different types and thicknesses of insulation were used for different areas of the façades depending on the range of factors that the insulation had to address

Secondary glazing was fitted to the sash windows

Influencing factor	Product name	Depth (mm)	Floor	Location	U value (W·m⁻²·K⁻¹)
Rigid thermoset plastic	Kingspan K17/18	180	LG	W&E walls	0.11
Blown cellulose	Warmcell 500	270	2	Ceiling	0.15
Aerogel/Styrofoam	Kingspan Styrozone N300R	30+140	LG	N wall	0.15
Wood fibre	Gutex Thermoroom	200	G&1	W wall	0.16
Vacuum-insulated panels	Kevothermal	30	LG	Floor	0.25
Calcium silicate board	Calsitherm	150	LG-2	Floor joists	0.3
Aerogel	Thermablok (aerogel and magnesium silicate board	30	1 + 2	W+E walls	0.32
iQ Therm	Remmers	50	G+2	N wall	0.38
Aerogel	Thermablok	20	G-2	W, N, E walls	0.41
Perlite beads	Perlite Silvapor	30	G-2	Stair stringer	0.58
Aerogel	Thermablok	10	1+2	W & E walls	0.58
Foamglas	Technopor Glas Foam – Ecostrata			N wall external	

Figure 1: The range, location and U value of each insulation material installed

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HOME TRUTHS

SPONNER / SHUTTERSTOCK

In his second report on the results of the Innovate UK Building Performance Evaluation programme, **Richard John** looks at why new homes rarely perform as well as their designers expect

Findings from Innovate UK's four-year Building Performance Evaluation (BPE) programme show that, on average, non-domestic buildings use 3.6 times more energy than predicted by their designers. The results, revealed last month, are broadly the same for domestic buildings; while some work really well, there is evidence of a yawning gap in performance for the majority. Average carbon emissions from the 350 homes studied, were 2.6 times higher than the average design intent.

The BPE programme also identified indoor air quality (IAQ) and overheating concerns in many of the buildings studied. In all cases, there were very significant lessons for the building services engineers.

So what was the difference between projects that had a small performance gap and those for which it was much wider? This question was asked earlier this year at a workshop of Innovate UK experts, appointed to act as critical friends to teams involved in BPE projects. The event, organised by the Knowledge Transfer Network (KTN), built on a National Energy Foundation (NEF) meta study of the performance of BPE projects involving a social landlord (see Figure 1).

After discussion with the Innovate UK experts, it was clear there were some common success factors associated with the best-performing buildings, including: committed clients; integrated design; clear documentation; and extended handover periods. (See panel, 'Success factors').

Ventilation and indoor air quality

The BPE projects showed that, although we are increasingly able to 'design tight', we haven't yet learned to 'ventilate right'. A meta study on ventilation, associated with the BPE programme, will be published shortly – as, one day, will the results of an ongoing indoor air quality study by the Department for Communities and Local Government (DCLG). Ahead of these, the experts workshop identified multiple issues from the BPE programme:

BPE air pressurisation tests showed that, sometimes, the fabric is much tighter than expected while, on other occasions, it is substantially leakier. The conundrum is that – in those cases where a building is substantially more leaky than planned – there is no longer a requirement for mechanical ventilation to provide the requisite levels of ventilation. Where buildings are much tighter than planned, the level of background air infiltration is sometimes such that regulations require additional ventilation

REPORTS AND SEMINAR

Innovate UK's BPE programme included more than 50 studies of 350 homes. Reports are available on the **Building Data Exchange** and the Knowledge Transfer Network's (KTN's) **BPE connect site.**

KTN is arranging a free seminar on housing issues arising from the BPE programme. To be on the invite list, email **valeria.branciforti@ktn-uk.org**

> A major source of the performance gap was building services

> Value engineering didn't always result in poor outcomes, although its implications in terms of realised building performance were not always thought through

> There was a common failure to design effectively to use building mass and minimise solar gain

> In practice, MVHR was often not functioning in line with the specification

systems to ensure good air quality. The Passivhaus buildings assessed under the BPE programme delivered the closest correlation between design and practice.

The BPE tests were often significantly different from compliance tests, perhaps reflecting the practice – sometimes applied ahead of the formal pressurisation test – of blocking gaps that would otherwise cause the building to fail. Based on the BPE data, the effectiveness of such fixes may be short-lived.

Where multiple airtightness testing was undertaken near the start and end of each project, there was no consistent finding. Airtightness could increase, stay broadly consistent, and even, occasionally, fall. The construction type, materials, and approach to maintaining airtightness during occupancy appeared to be key principles.

It was clear that, in practice, mechanical ventilation with heat recovery (MVHR) systems were often not functioning in line with their specification (airflow rates and efficiencies) and the same issues were found with mechanical extract ventilation (MEV). Where MVHR and MEV systems performed poorly, the underlying cause was a combination of design, installation, commissioning and operating issues.

Examples of operating issues included occupants turning off units, or not using them correctly, because of noise, perceived energy cost, or lack of understanding. Filters not being cleaned/changed was another issue, as was new carpets blocking air pathways through the building.

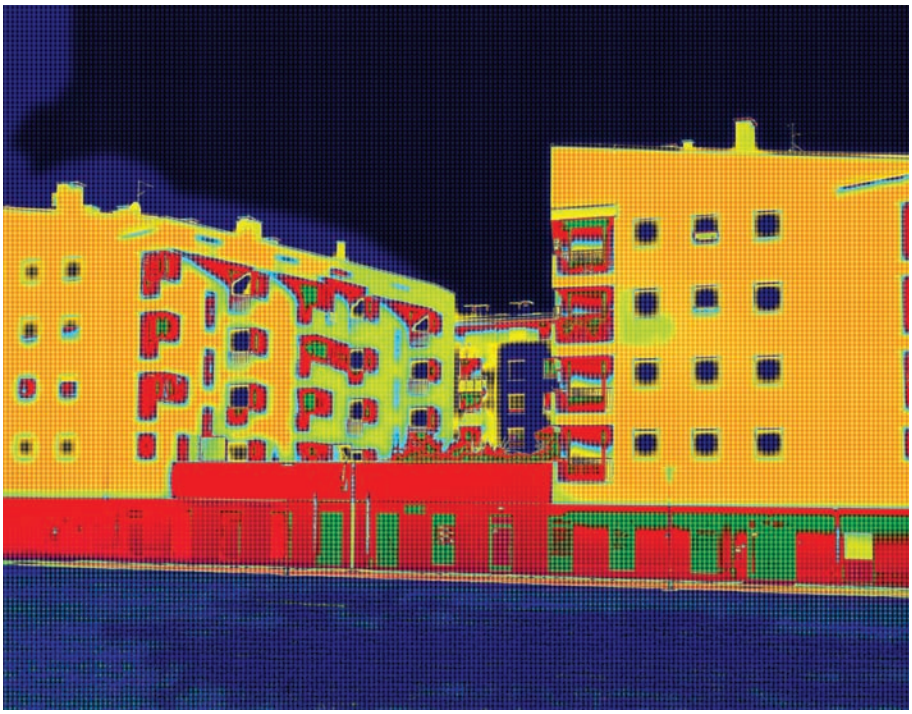
Not all MVHR systems were designed to be readily accessed for maintenance; flexible ductwork was sometimes used – and abused – in excess quantities. Nor were all control systems intuitive for occupiers. Passive ventilation was also not a panacea for good air quality; for example, some occupants blocked the use of trickle ventilators, or were unwilling to open windows.

On top of all this, actual occupancy rates and behaviour is often different from that assumed at the design stage.

This led one workshop participant to suggest that the only effective way forward was to link future ventilation systems to a measurement of IAQ, and to use this to alert occupants as to poor air quality.

Many of the BPE projects identified overheating as an issue. There was a common failure to design effectively to use building mass and minimise solar gain, and there were instances where building services engineers could have done more to mitigate solar overheating. These included properly insulating services and ensuring MVHR units both have a summer bypass fitted, and operate as per design intent. Limitations on window opening also restricted occupant control of overheating.

Although there were instances of significant variances between 'as designed' and 'as built' air permeability and fabric insulation values, a major source of the performance gap was building services. Most low or zero carbon technologies and community heating schemes performed



IVAN SMUK / SHUTTERSTOCK

Infrared thermovision image showing lack of thermal insulation on a residential building


Wimbish Passivhaus development was one of the few that performed well


The Hastoe Housing Association affordable homes were designed by Parsons + Whittley

less well than more traditional systems. This perhaps reflects the lack of client and supply chain experience. Photovoltaics (PV) was a general exception to this, with most systems performing close to expectations – although there were exceptions even here.

Generally, it was suggested, a traditional procurement route appeared to provide better performance outcomes than design-build. Value engineering didn't always result in poor outcomes, although its implications in terms of realised building performance were not always thought through. A soft landings approach to housing development was also seen as being important.

Perhaps the key lesson arising from the programme isn't so much the various performance gaps, occupant behaviours, and impact of new technology, but how far organisations are willing and able to learn and adapt. As one participant at the experts workshop observed: 'The organisations benefiting the most are those that have learned from the BPE programme, and who are changing practice as a result.' **CJ**

Success factors

- **Committed client and owners:** Where housing associations were the client, their track record in developing environmentally sensitive buildings – and their commitment to make these buildings work – were important factors. Having occupants who were committed to ensuring successful operation was also key
- **Quality:** Particularly where new technologies or construction techniques are being employed, supply chain experience and a systemic approach to quality were important. New technologies or approaches coupled with few (if any) validation checks usually led to a large performance gap. Buildings constructed to a Passivhaus standard tended to operate much closer to design intent than most other buildings studied. The Passivhaus approach to quality appeared to result in greater attention to design and construction detail, although it was also usually associated with committed clients
- **An integrated design approach and manageable complexity:** This was most apparent in its absence as a risk factor. Services 'bolted on' to meet a regulatory or labelling goal almost inevitably underperformed. Usually, simpler systems worked best, although the Hastoe Housing project showed how a fairly sophisticated set of systems could be made to work together where there was experience and commitment. A failure to engage building services engineers at an early stage had foreseeable consequences
- **Handover:** Where systems such as MVHR, biomass boilers and solar water heating were new to occupiers and facilities teams, good, simple documentation, and a handover period with extended support, were important success factors. Homes that occupants could use without having to master systems first, were identified by the experts as the most successful.

COST MODEL

COMMERCIAL OFFICES CENTRAL LONDON

The demand for high-grade office space in London continues to outstrip supply. Aecom looks at the capital cost of building services for the shell and core – and fit out – of a central London office

In this cost model, covering mechanical, electrical and public health (MEP) services, Aecom examines the capital cost of the shell and core – and Category A fit out – of a central London commercial office with a gross internal floor area (GIFA) of 20,000m². The model features fan coil units, water-cooled chillers, cooling towers, passenger lifts and LED lighting.

Background to the model

Demand for high-grade office space in Central London has been growing rapidly as the market moves away from the devastating impacts of the 2008 recession. With the capital's population projected to hit 10 million by 2030, this will only continue.

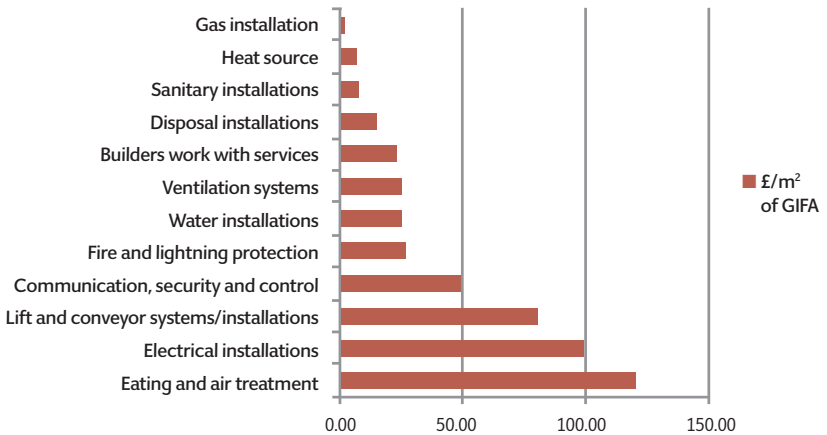
As the market grows, demand is changing in line with the improvements being made in construction, and the shift in spatial needs. Commercial developers are focusing on buildings with high floor-to-ceiling heights, allowing for increased natural light and flexibility in design to react to contrasting heating and cooling needs. Tenants are aspiring to have efficient and low-energy buildings, to minimise operating costs and give them greater long-term value for money.

Modern companies are demanding more open-plan spaces and breakout areas, and are keen to use this space differently as they evolve and grow, rather than be restricted by a limited design. It has become commonplace for developers to think about flexibility early on in the design process, and to provide dedicated riser and plant space, or a base build design that is easily adaptable.

Tastes have also evolved and, increasingly, new office schemes have a more 'industrial feel', with exposed services and soffits rather than suspended ceilings. These approaches require higher standards of finishes and greater coordination of the services, which may result in a more expensive solution.

Hot desking and remote working are also become more prevalent, to fit around people's lives. This means occupation densities in offices can vary throughout the day, so services must be designed to accommodate this. Linked to this is a shift in the basis for occupation density, as developers become keener to work to one person per 8-10m² of net internal area (NIA) rather than the traditional approach of one

Cost of services for shell and core in a central London office



Representation of relative costs of services for an office with gross internal floor area (GIFA) of 20,000m²

PCRUCIATTI / SHUTTERSTOCK

ALICE-PHOTO / SHUTTERSTOCK

person per 10-12m² of NIA.

A recent British Council for Offices (BCO) report identified a tendency among developers to design to the 'worst-case scenario', instead of trying to understand how a potential tenant's needs will change over time, enabling them to adapt to specific increased demands on building services.

In response to this report, developers are designing buildings that can cater for potential increased demands on particular floors or a percentage of overall NIA.

In addition, they are becoming increasingly open-minded – when considering future demands on plant, toilets and lifts – that the building can be easily modified, and or adapted as a response to any demand for increased density.

Services design

The first and most important question is where the primary plant will be located – on roof level, in the basement or both. The choice will largely depend on whether either of the spaces has been designed to be used for another purpose. An increasingly common design feature is private terrace spaces for tenant use, particularly the hosting of events.

Another consideration is whether the primary plant will be better serviced by being located at high or low level; developers can incur sizeable capital costs if they are required to route boiler or generator flues to roof level to comply with City of London requirements. Other important factors are whether there is sufficient space and flexibility for additional generators, uninterruptible power supplies, and additional air conditioning capacity so buildings can grow with their occupiers.

Developers generally now consider installing the backbone fibre infrastructure through the vertical cores, so future tenants are not required, at great expense, to go back in and install the infrastructure themselves. Tenants can then use this on a floor-by-floor basis. In this way, developers are in a better position to manage the prospective tenants' requirements early in the design process, to maximise flexibility and security.

Tenants are keen to occupy buildings that are secure without a fortified and imposing appearance, with bollards and security gates. They are looking at alternative measures, including: facial recognition; retinal and fingerprint scanning; and quick response (QR) technology on smartphones and CCTV. This can ensure a building feels welcoming and accessible without compromising on security.

Lifts with destination-hall control are

ABOUT THE AUTHORS

The engineering services cost management group of Aecom specialises in the cost estimating, procurement and cost management of building services installations. It is producing a series of cost models for *CIBSE Journal* in 2016, on areas such as data centres and London's commercial buildings.

AECOM

JAVEN / SHUTTERSTOCK

Shell and core works	Based on GIFA of 20,000m²		
	Total (£'000)	£/m² of GIFA	% of total MEP cost
Sanitary installations Sanitary appliances, including WCs, wash hand basins, cleaners' sinks, urinals, showers, and the provision of disabled toilets and accessible showers. The showers are assumed to be located in the basement, within the male and female changing rooms, and are for fittings only.	300	15.00	3.12
Disposal installations Soil, waste and vent installation to all sanitaryware points. The installation of a rainwater disposal system, including a rainwater attenuation system (assumed 100m³). An allowance has been made to provide capped-off drainage connections to kitchenettes and retail units on the ground floor. Condensate drainage for fan coil units, including insulation.	300	15.00	3.12
Water installations Installation of mains cold water services – including storage tanks, pumps, water softening, salt saturators – and connections to sanitaryware. Installation of hot water services, including distribution, pump sets and connections to sanitaryware. Provision of capped-off cold- and hot-water services to office floor kitchenettes and retail units. An allowance has also been made for potential miscellaneous water points.	500	25.00	5.20
Heat source Low-emission condensing boiler plant (located in basement) with heat exchanger, flue to roof with fan-assisted flue dilution (roof mounted), associated pump sets and primary distribution pipework and insulation.	140	7.00	1.46
Space heating and air treatment Water-cooled chillers; roof-mounted cooling towers, inclusive of water treatment and acoustic requirements. Installation of condenser water system, including primary distribution and pumps. Installation of chilled water distribution system, including pumps, pipework, valves and insulation. Low temperature hot water distribution system, including pumps, pipework, valves and insulation. Metering to CHW and LTHW systems. Air handling units and associated supply and extract ductwork distribution. Dedicated reception air conditioning system, and any necessary supplementary heating and cooling.	2,400	12.00	24.98
Ventilation systems Toilet and shower supply and extract system, ventilation systems to plantrooms, lift-motor rooms and refuse areas. Installation of basement and car park ventilation systems. Provision of stair and lobby pressurisation system.	500	25.00	5.20
Electrical installations HV installations, including switchgear and transformers. Installation of LV distribution system, including switchgear, primary containment, cabling and rising busbar. Power to mechanical plant, installation of small power and lighting, including emergency lighting and controls to landlord areas. Enhanced lighting to lift lobbies, reception areas and toilets. Installation of external lighting. Provision of life-safety generator system only, including fuel, flues and acoustic treatment. Earthing and bonding.	2,000	100.00	20.82
Gas installation Installation of gas service to condensing boiler.	40	2.00	0.42
Fire and lightning protection Sprinkler system, including tanks, pumps and risers. Gaseous suppression systems to switch rooms and generator room. Installation of dry risers and lightning protection.	534	26.70	5.56
Communication, security and control systems Installation of fire alarm systems, including interface panels, head end equipment and terminal devices. Provision of landlord security system, including CCTV, access control and security turnstiles to reception area. Provision of a disabled alarm system, refuge alarms and induction loops to reception/lobbies. Installation of central BMS, including central control panels and BMS to plant and equipment.	985	49.25	10.25
Lift and conveyor systems/installations Installation of six passenger lifts (21 person, 2.5m/s, DDA compliant) with enhanced finishes serving ground to level 8. One goods lift serving all floors, two firefighting lifts serving all floors. Destination control system to all passenger lifts.	1,600	80.00	16.66
Builders work in connection with services BWIC for services installations including fire stopping.	457	22.87	4.76
Shell and core total cost	**9,606**	**480.32**	**100**

Cost of shell and core works for office with gross internal floor area (GIFA) of 20,000m²

becoming standard, while LED lighting to Category A areas is also becoming the norm.

Prices are returning to the peak levels experienced before 2008, but the relative weakness of the euro has kept the cost of components artificially low. When this changes, it will be a key driver of inflation, and will affect certain MEP elements, including lifts and primary plant, such as switchboards, chillers and generators. These are often sourced from the Eurozone, so there is the potential for them to become risk items.

Feedback from firms in the London MEP market, gathered as part of Aecom's recent *Market Intelligence Report*, emphasised the optimism around the sector's growth prospects. On average, 70% of projected income for 2016 had been secured by the end of 2015, against forecast increases in order-book values of 20-30%.

Cost model

The cost model is based on a central London office development arranged over eight floors, with one basement floor. It has a GIFA of 20,000m², with an approximate net lettable area of 14,500m² – resulting in a net to gross efficiency of 72.5%. The office has been designed to comply with Part L and to achieve a BREEAM Excellent rating. The occupational density (total NIA divided by the total number of workplaces in the building) of the scheme has been assumed to be 1:8.

Generally, for a speculative office development, we would expect a net to gross efficiency of 78% to 82%. However, this model is based on a development designed with a ground floor containing a large open reception area and non-lettable, back-of-house areas, including a loading bay and car park.

Costs are base dated on Q1 2016, and the prices used are reflective of a project procured through a competitive two-stage tender

RON ELLIS / SHUTTERSTOCK

process. The model includes subcontractor preliminaries, testing and commissioning, and only 'builder's work in connection' (BWIC) as a result of other works. Costs to complete the services fit out beyond a Category A standard, professional fees, tenant enhancements and VAT are all excluded.

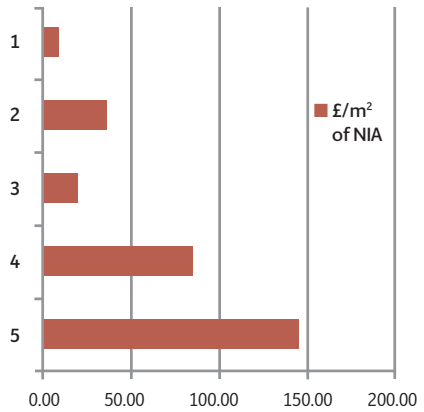
The cost model is based on a steel-framed building, with a traditional four-pipe fan coil unit (FCU) system. However, there has been growth in the market for alternative design solutions, which will influence the overall capital cost. Primarily, these alternative designs expose the services and the soffit of the slab, with options on which services strategy is employed, including FCUs, chilled ceilings, chilled beams or chilled mats. For example, on a four-pipe FCU system, the cost to move from a basic industrial look to a highly aesthetic look will have a significant bearing on the cost, between £0 and £60/m².

Chilled ceiling solutions have been widely used in Europe, but have not been taken up to the same extent in the UK. The market is shifting towards this technology, with developers market-testing design options against the traditional FCU design.

Occupancy density, floor-to-ceiling heights, zoning parameters, floor plate size and shape, and product cooling outputs influence the capital cost. For a central London office, this will add £50 to £150/m² to the base cost model. **CJ**

This cost model has been written by **ALEX GROCOTT**, graduate surveyor, engineering services, and **MAT BURGERS**, director, engineering services

Cost of services in Category A fit out



1 Builders' work - services
2 Communication, security and control systems
3 Protective installations
4 Electrical installations
5 Space heating and air treatment

Representation of relative cost of Category A works

Category A works	Based on NIA of 14,500m²		
	Total (£)	£/m² of GIFA	% of total MEP cost
Space heating and air treatment Installation of four-pipe fan coil system, including CHW and LTHW distribution and insulation. Installation of distribution ductwork, plenums, grilles, diffusers and insulation. Installation of condensate drainage to serve FCUs.	2,102,500	145.00	49.22
Electrical installations Installation of distribution boards to each floor, LED lighting and emergency lighting, including controls (based on a modular wiring system). Provision of power to mechanical services, installation of small power, earthing and bonding.	1,232,500	85.00	28.85
Protective installations Sprinkler protection to all office floors	290,000	20.00	6.79
Communication, security and control systems Fire-detection and voice-evacuation systems. BMS controls to fan coil units.	522,000	36.00	12.22
Builders' work in connection with services BWIC for services installations, including fire stopping @ 3%	124,410	8.58	2.91
Category A total cost	**4,271,410**	**294.58**	**100.00**

Total cost of Category A works for an office with net internal area (NIA) of 14,500m²

MODELLING FOR BETTER PERFORMANCE

Building performance modelling has come a long way since 1998, so an updated CIBSE guide on the subject is a welcome addition to the designer's toolkit. **Hazim Awbi** highlights the key changes in AM11

> The manual deals with some of the rapidly evolving issues related to BPM, dictated by changes in energy performance regulation

It has been more than 17 years since the Application Manual (AM11) *Building energy and environment modelling* was first published, and many developments in the tools for – and approaches to – modelling of buildings have occurred since then.

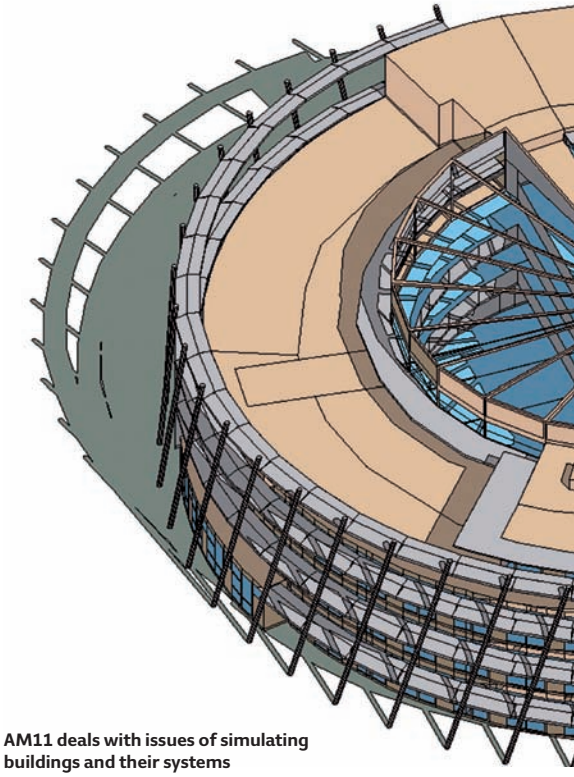
So the CIBSE Building Simulation Group decided to update this manual to reflect the vast progress in modelling over the past two decades, and – late last year – AM11 *Building Performance Modelling* (BPM) was published. It has been written by building design and modelling software experts, from academia and engineering practices, who have pooled their knowledge on the application of these tools to building and system designs.

BPM covers the general concepts of energy and environmental modelling and, in particular, focuses on: quality assurance procedures; compliance with UK and international building energy efficiency codes; thermal environment and energy; ventilation; lighting; and plant modelling. The new manual also deals with some of the rapidly evolving issues related to building performance modelling dictated by changes in energy performance regulation.

It is assumed that readers of the new AM will have at least basic knowledge of the modelling and simulation tools covered in the manual, and sufficient understanding of the building physics related to these tools. Chapter 1 is a general introduction, while brief highlights of the manual's other chapters are given below.

Chapter 2: Quality assurance

The principal author is technical director at Aecom, Foroutan Parand. He sets out the quality assurance procedures recommended to ensure modelling is performed according to defined criteria, and that results are a true reflection of the proposed aims. Some of the guidelines presented are general in nature and applicable to different modelling processes; however, some more specific procedures relevant to certain types of modelling are also outlined. Matters related to software capabilities – including selection, limitations and validation – are also discussed.



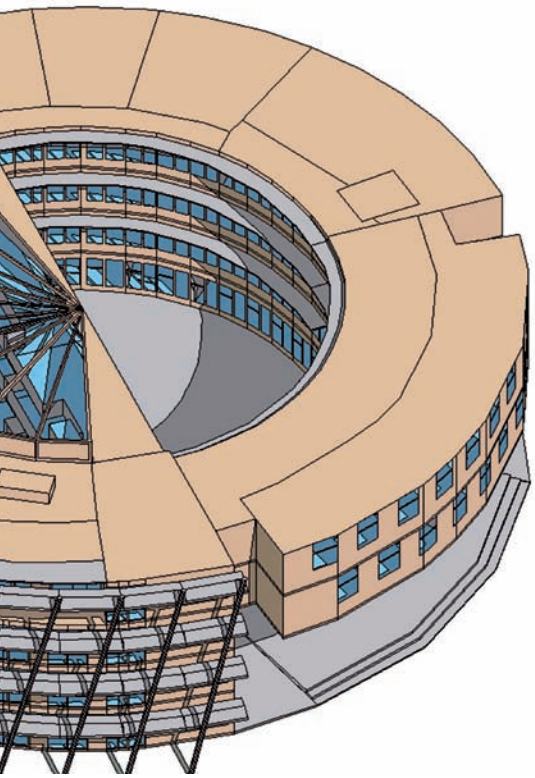
AM11 deals with issues of simulating buildings and their systems

Chapter 3: Modelling for building energy performance regulations

This focuses on how to ensure building modelling demonstrates compliance with energy performance regulations and certification. It particularly focuses on UK regulations, but also considers the European Energy Performance of Buildings Directive (EPBD), and directives in other countries. The principal author of this chapter, Rokia Raslan – lecturer in building performance simulation at the UCL Institute for Environmental Design and Engineering – also outlines well-known building assessment and rating schemes, such as BREEAM in the UK, Green Star, of the Green Building Council of Australia, and the Estidama Pearl system of the UAE.

Chapter 4: Energy modelling

The application of hourly energy simulation methodologies is the subject of this chapter, principally written by WSP-Parsons Brinckerhoff technical director David Williams. The processes involved are described in detail – for example, defining the design questions to be considered; transforming the concepts into modelling objectives; preparing the most appropriate models; executing the simulations; and interpreting the results. Various modelling approaches for estimating a building's energy demand – and their limitations – are discussed briefly, while a



more detailed description is given of dynamic thermal modelling (DTM). The numerical procedures used in DTM for hourly/sub-hourly simulations are highlighted, and the practical issues when doing this type of simulation are outlined, namely:

- Geometry and zoning
- Choice of climatic data
- Properties of building materials
- Solar gain and shading
- Daylighting
- Ventilation and air infiltration
- Internal gains scheduling
- Auxiliary building loads
- Control plants

Chapter 5: Thermal environment modelling

With Aecom associate director Malcolm Orme as the principal author, this chapter considers interaction between thermal environment modelling parameters, and their impact on the provision of thermal comfort for building occupants. A range of standards – and the comfort models recommended by these standards – are described; these include the predicted mean vote (PMV)/predicted percentage of dissatisfied (PPD) model of Povl Ole Fanger, and the adaptive thermal comfort models. Their principles, and recommendations on when/where to use the most appropriate model, are discussed, as are bioheat models and their link with computational fluid dynamics simulation of the occupied local environment.

Chapter 6: Ventilation modelling

Modelling air movement in naturally and mechanically ventilated buildings is the focus of this chapter, the main author of which is professor of building performance analysis at Loughborough University, Malcolm Cook. It covers the basic principles of a zonal network, plus CFD modelling of ventilation and air movement in buildings. The CFD part addresses: concepts; turbulence models recommended for building ventilation simulation; transport models of airborne particles; radiation modelling; boundary conditions for air movement and heat transfer; and computational meshing techniques used in CFD simulations. Solution control procedures and model output presentations are also discussed, as is modelling the wind flow in local urban environments.

Chapter 7: Lighting modelling

The provision of daylighting is a priority for designers, because spaces without daylight and external views are not favoured by occupants. In Chapter 7, Professor of Building Daylight Modelling at Loughborough University, John Mardaljevic, discusses the modelling of daylighting and, to a lesser extent, artificial lighting. He also describes climate-based daylighting modelling and artificial lighting, including their energy-use assessments.

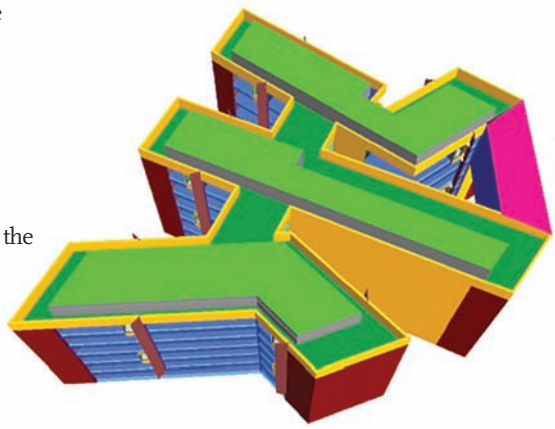


Figure 1: Image of thermal model

Chapter 8: Modelling of plant and renewable energy systems

Chris Underwood, Professor of Energy Modelling for the Built Environment at University of Northumbria, looks at the modelling of HVAC plants, controls and renewable energy systems. Key principles of treating plant and control systems used in building simulation are discussed, including idealised control functions, steady-state component-level modelling, and fully dynamic modelling. The modelling approaches outlined are complemented by examples and case studies involving plant and renewable energy systems, such as photovoltaic (PV) panels, solar thermal collectors, building-integrated wind generators and ground source heat pumps. Several computer programs for plant modelling are also described, offering the reader a choice of program for particular modelling tasks being considered.

Chapter 9: Case studies

This chapter includes case studies of various aspects of building simulations, and is written by director at Building Physics, Darren Coppins, with support from several co-authors. Its aim is to make readers aware of the diversity of modelling tools, how they are used in practice, and relevant issues. The case studies cover a wide range of buildings and simulation tools used, and examples are shown in Figures 1 and 2.

It is intended to review major changes that may effect the AM11 manual. Sections will be updated at **www.cibse.org** CJ

● **HAZIM AWBI** is chair of the AM11 steering committee

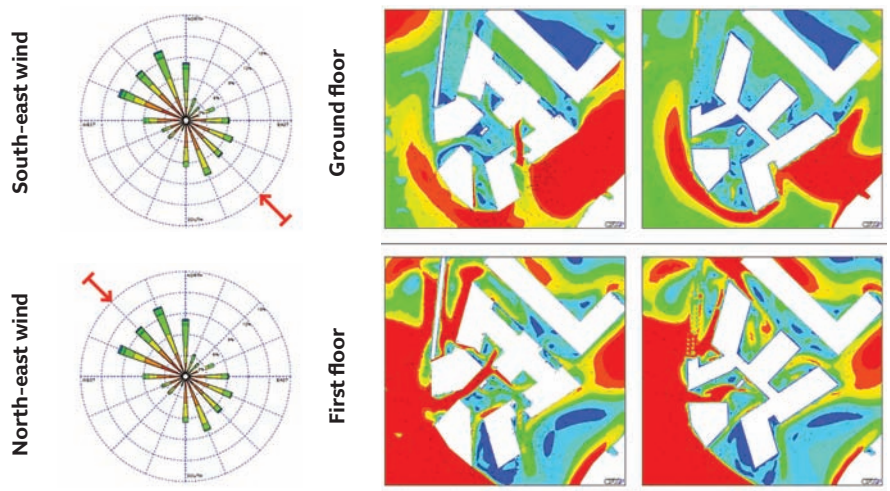


Figure 2: Wind speed at ground- and first-floor levels for two wind directions

MONEY FOR NEW HOPE

From next year, large employers will pay a levy to support apprenticeships that aim to alleviate the skills shortage – so will they, and their potential trainees, get a good return on their investment? **Roxane McMeeken** finds out

The UK government plans to create three million apprenticeships by summer 2020, a 35% increase on the previous five years. From 2017, larger employers will pay a contribution towards funding these apprenticeships, and this levy – along with an emerging range of employer-designed 'Trailblazer' apprenticeships – heralds a new era for this method of training.

If you are thinking of a career in engineering, why not consider an apprenticeship, rather than going straight to university – not least because you could save thousands in degree-course fees? If you are an employer, apprentices are part of the solution to the skills shortage. Here, we look at the benefits for employee and employer, including the key facts about apprenticeships.

What employees need to know

Apprentices earn from day one, often making around £200 per week. In building services engineering, an apprentice's week will typically involve four days at work and one at college, plus study in your spare time.

Apprenticeships lead to recognised qualifications, such as a National Vocational Qualification (NVQ), a technical certificate and – if you follow an 'advanced apprenticeship' (see table) – a BTEC, diploma or foundation degree.

If you work in building services engineering and complete an advanced

apprenticeship, you will be qualified to join CIBSE as a 'licentiate' member and to put the letters EngTech LCIBSE after your name.

You could start as an apprentice and progress to degree or even Master's level, with your employer paying all the tuition fees.

Apprentices can progress faster than those who enter the industry as graduates to being a chartered building services engineer – that is, a chartered member of CIBSE, a step up from licentiate member.

Angela Ringguth, CIBSE's professional development consultant, says: 'It's possible – if you start as an apprentice at the age of 18 and achieve your qualifications by part-time study, alongside practical work in the industry – that you could find yourself ahead of someone who opted for full-time study and only starts work in the sector in their 20s.'

Those who attain a 'higher apprenticeship' (see table) earn more, on average, over their lifetime than those with undergraduate degrees from non-Russell Group universities. Research from Boston Consulting found that lifetime earnings for higher apprentices are around £1.5m, compared with £1.4m for those with a non-Russell Group degree.

What employers need to know

The apprenticeship levy will be introduced in April 2017, at the rate of 0.5% of an employer's pay bill. It will only apply to employers whose pay bill is more than £3m.

As all large employers must pay the levy, regardless of whether they participate in the scheme, it makes sense for them to benefit from the levy by taking on apprentices.

'Trailblazer' apprenticeships are schemes being developed by groups of employers, working with trade bodies. They are designed to attain professional recognition, so are well aligned to the precise needs of specific areas of industry, as well as the requirements for trade-body membership.

It pays to offer Trailblazer apprenticeships. 'Employers will get government funding and support for the people they take on and develop,' says Ringguth. 'So it's in employers' interests to engage with the scheme – especially as we are seeing such a demand for new skills in our sector. There is also a lot of new work, both around and in prospect, with the government's ambitious building targets.'

If you are concerned about investing in an apprentice who might not stay on after qualifying, some firms use an employment contract that requires the apprentice to pay back part or all of their training costs, should they leave before a certain period. **CJ**

Apprenticeships offer the chance for young people to earn and learn

CREDIT: HOARE LEA

> The trainees we have taken on have settled quickly, and senior staff have been impressed with the contribution they have made. The only question is why we didn't do this years ago
> – *Hoare Lea*

FOR MORE INFORMATION VISIT:

- The National Apprenticeship Service at **www.apprenticeships.gov.uk** – a 'one-stop shop' for information about apprenticeships and vacancies in England. It also contains links to websites for schemes in Scotland, Wales and Northern Ireland
- CIBSE: Search 'CIBSE careers fact sheets' and click on 'Apprenticeships'

The apprentice's view

Caitlin Stuart (left) won the 2015 Apprentice of the Year award, presented by Women in Science, Technology and Engineering, for her outstanding contribution to her organisation.

Stuart, a building services design technician, was taken on as an apprentice by Troup Bywaters + Anders (TB+A). She completed a BTEC level 3 in building services at South Thames College and has recently started a degree course, paid for by TB+A.

'When I was at school, university was the last thing I wanted to do,' she says. 'I chose an apprenticeship because I wanted to start earning; I didn't want to spend all my time just studying, but rather combine learning with work. There was also no way I could afford to pay for a degree.

'I chose a building services BTEC because I was really into engineering at school, and it offered the brilliant combination of engineering and the creative side, which is design. Now I've completed it, TB+A has told me I could progress my career a lot faster if I get a degree, so I've started a four-year course, part-time.

'I do Mondays at university, from 9am to 7pm, and then work for the rest of the week. It is a busy week, but you learn faster. Plus, I am earning money and don't have to pay tuition fees. I feel lucky compared with other students, who have no money, no work experience and no guarantee of a job at the end of their course.

'I am currently doing the electrical design for a building at Canary Wharf. At TB+A, you feel really supported; they offer you the chance to get involved with interesting pieces of work. You go to client meetings, meet the architects, and then you've got the responsibility of designing your own bit of the project.

'I would recommend an apprenticeship. I've got two qualifications already [NVQ and BTEC], you have a great time at work, and it feels like there is no limit to where it could take you.

'Winning Apprentice of the Year feels amazing; it's nice to know that putting in so much hard work and dedication pays off!'

The employers' view

Hoare Lee launched an apprenticeship scheme in 2012. Paul Tymkow, the firm's director of learning and knowledge, says: 'We felt we needed more breadth in our intake – there are a lot of different roles to fill and you need a mix of skills to fulfil them all in the most effective way.

'We also want to catch people earlier, because – by the graduate stage – there is a lot of competition for candidates.

'The trainees we have taken on have settled quickly, and senior staff have been impressed with the contribution they have made. The only question is why we didn't do this years ago.'

Balfour Beatty recruits 150 apprentices a year and leads an employers' group designing Trailblazer apprenticeships. 'Young, innovative workers are the future of the industry, so training, apprenticeships and upskilling are vital to our economy,' says a spokesman for the company.

SPECIAL FEATURES

● WATER HEATING ● DATA CENTRES

This month: Data centres in a cold climate and plate heat exchangers in water heaters

Free cooling and an abundance of low-carbon hydro power is making the Arctic a viable site for data centres. **Alan Beresford** explains how EcoCooling is taking advantage of the climate at the Hydro66 data centre in Boden, Sweden

NORTHERN EXPOSURE

There has been a surge of investment recently in data centres in the remote north of Sweden, including Hydro66 at Boden and Facebook at Luleå. The obvious reason for this is the cold climate, which supports 'free' cooling and so reduces the considerable cost of taking the heat out of modern data centres.

This article describes how Hydro66 has implemented a direct fresh-air cooling system, supported by evaporative cooling, to produce one of the most efficient data centres in the world. Other factors in this region can reduce the capital and operating costs of a data centre, and will also be discussed.

Hydro66 has recently completed and populated the first phase of a 20MW data centre in Boden, which – together with the towns of Luleå, Älvsbyn and Piteå – has formed the Node Pole Alliance. The aim of this association is to make the most of the vast natural resources of this area to attract data centre investment. The key advantages are low-cost cooling and power, and practically unlimited renewable generation capacity and grid infrastructure to support large centres.

A key objective of Hydro66 was to design the data centre to operate at a power usage effectiveness (PUE) – the ratio of total amount of energy used by a data centre to the energy delivered to computing equipment – of less than 1.05. This could only be achieved using fresh-air cooling supported by the most efficient uninterruptible power supply (UPS) and power distribution.

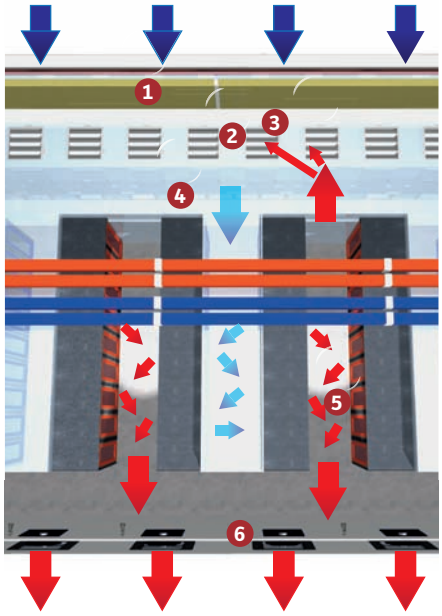
Boden lies on the 66th latitude and, consequently, is cold, with a record low temperature of -40°C and a maximum of 32°C, although it rarely exceeds 25°C. In this climate, a simple ventilation system can maintain compliant temperatures for much of the time, but in the few instances a year when the ambient exceeds 25°C, a supplementary cooling system is required. The options for this are chilled water, direct expansion (DX), and direct or indirect evaporative cooling.

A well-designed chilled water system can be very efficient but expensive. It is also only viable for larger cooling loads. The market for a data centre such as Hydro66 is in 'colocation', where equipment, space, and bandwidth are available for rental to retail customers. The

Boden's data centres and infrastructure

1 KNC data processing facilities **2** Hydro66 Europe-1 3.8MW phase 1, 40MW total capacity **3** 78MW hydro dam **4** 145kV hydro dam **5** 145kV national grid **6** H66 20kV feed B **7** H66 20kV feed B **8** 120MV sub station **9** 145kV national grid **10** Bio gas generation plant

Apart from the advantages of low cooling cost, the Node Pole area offers some very strategic advantages related to electricity supply. All of the power is generated from hydro, which provides a completely renewable electrical supply at less than 20% of the cost of western European generation. With a 1MW data centre typically having electricity costs of £1m, this is obviously an attractive commercial solution. There is also an opportunity to exploit the diverse power stations available in the area with low harmonic interference, to remove the requirement for standby generators and UPS infrastructure.



1 Triple filtration stage **2** Aidabatic aircon unit
3 Hot air recirculation system **4** Contained cold aisle
5 Contained hot aisle **6** Hot air exit fan

Schematic showing hot and cold aisle configuration

final cooling loads are not known at the time of construction, so it is impossible to size a chilled water system to reflect an unknown load.

IT equipment is normally installed in 600mm-wide racks, and rack loads can vary between 2kW and 15kW, depending on the type of equipment installed. This is why most data centres take the DX route; units of up to 100kW of cooling load can be added in a modular way, reflecting the cooling load as the computer racks are populated.

Indirect cooling is the next option; outside air passes on one side of a heat exchanger and the hot air from the centre passes on the other side. The amount of heat extracted is dependent on the outside temperature. On warm days, the ambient (outdoor) air is adiabatically cooled using wetted pads or sprays, and – on very hot days – a DX coil is added to maintain compliant conditions.

> Boden is cold, with a maximum temperature of 32°C, so a simple ventilation system can maintain compliant temperatures

The obvious key advantage of an indirect ventilation system is that any contaminants in the external air are not brought into the data centre. Because indirect cooling systems require large heat exchangers, the equipment is big and can be expensive. Also, in the case of Hydro66, the Boden planning authorities preferred solutions with no external plant.

Hydro66 decided to use a direct ventilation system supplemented by evaporative cooling. The equipment is modular and installed internally, thereby avoiding planning issues. Electronically commutated (EC) axial fans are used for air movement because they are easier to install and take up less space than centrifugal fans. With very low pressures, axials can also accommodate the larger flow rates and pressure, and their motors are efficient, quiet and have simple speed controls.

The efficiency of a fan is approximately proportional to the cube of the speed. Data centres require redundancy of N+1, 2N or 2(N+1), so equipment is operated at part capacity. By controlling all of the EC fans as a group – and reducing the air flow rate to that required by the IT equipment – reductions in consumed fan power can be achieved, producing remarkable efficiencies.

On average, 1MW of IT equipment will require an airflow of 90m^3/s of air at compliant temperatures. A ventilation system, based on EC axial fans, can support 1MW of cooling for approximately 40kW of fan energy use. This adds 0.04 to the PUE of the data centre. If – as in the case of Hydro66 – this is used in conjunction with a rotary UPS solution (a flywheel driven by an electric motor) where losses are <1%, a PUE of 1.05 is attained. Since the data centre has both redundancy and spare capacity, the ventilation rate is reduced and further savings are made. For example, running a fan at 80% reduces energy use by half and, at 50%, to 12.5%.

An intelligent control system is used by Hydro66 constantly to optimise the fan energy use to reflect actual cooling requirements in a dynamic environment. On warmer days, the adiabatic cooling is enabled, bringing the supply air down to approach the wet-bulb temperature of the ambient air. In Boden, this means the supply air will never exceed 22°C, which is compliant with all standards without the need to use additional mechanical refrigeration. The use of adiabatic cooling will increase the moisture content, while reducing dry-bulb temperature, so increasing the relative humidity of the air.

With reference to the ASHRAE 2011 Thermal Guidelines, high relative humidity (RH) will normally only cause corrosion with other contaminants in the air. If gases such as sulphur or chlorine are in the ambient air, these, plus high RH, can cause corrosion. Boden has 'clean' air because there are no local industries producing contaminants.

The combination of high RH and dust or particulates can also create problems, so all incoming and recirculating air is filtered. In relatively clean conditions such as those in Boden, EU4 is a suitable level of filtration. Increasing this can result in significant increases in capital cost, maintenance requirements and fan energy use.

A direct fresh-air system operating in arctic conditions at the coldest time of the year can result in very low RH in the data centre. Low RH, in conjunction with other factors, can cause problems with electrostatic discharge (ESD), which can damage IT equipment. The Hydro66 cooling system incorporates a recirculation loop, where – in low RH conditions – the warm air from the data centre is passed over the adiabatic pads to humidify the air above the ASHRAE 2011 Thermal Guidelines' allowable level of 20%. This novel solution therefore uses the adiabatic pads for two functions – cooling in hot weather and humidification in cold weather conditions.

Hydro66 has constructed a low capital cost, flexible data centre, which has achieved a PUE of less than 1.05. The direct fresh-air cooling system complements the commercial strategy with a modular system that supports this progressive development. **CJ**

ALAN BERESFORD is managing director of EcoCooling, www.hydro66.com

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Joshua Eckett, Buro Happold (progressed from LCIBSE EngTech to MCIBSE IEng in 2014).

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SERVED UP ON A PLATE

Plate heat exchangers enable hot water in buildings to be supplied only when it is required by occupants. **Peter Filbert** looks at the 'on-demand' alternative to storage vessels

Contemporary commercial gas boilers bear little resemblance to the models that dominated plantrooms beneath offices, schools, shops, hospitals and other premises in the second half of the last century. They have been transformed in terms of their efficiency, scale, reliability and safety.

In tandem with mainly mechanical improvements in components such as burners, gas valves, pumps, flues and heat exchangers, there has been a revolution in the control systems, sensors and other electronics that optimise boilers' performance.

Nowadays, high-efficiency boilers are fully modulating and feature an automatically controlled premix to match output to demand. As well as extracting the maximum energy from the gas burned, this results in very low NO_x and carbon dioxide generation. They also feature much lower water content than conventional boilers, with a far larger heat exchanger surface area.

Modern condensing boilers are often installed in a cascade arrangement, with units ramping up and down to meet demand; when no hot water or heating output is required, they turn off, simply maintaining temperature in their own primary circuits. A modern plantroom is a clean, compact and contemporary building services solution, but there has been an even more radical change in the means by which hot water is delivered.

Demand for hot water varies greatly depending on the purpose of a property. A hotel, for instance, is subject to different peaks from an office or a school. Stokvis Energy Systems has been involved in many contracts to replace cumbersome, wasteful and potentially dangerous hot-water storage vessels with technically superior packaged plate heat exchangers. Where maintaining the temperature in large volumes of stored hot water requires constant energy input, plate heat exchangers (PHE) are the 'on demand' alternative. They feature very low water content and comprise a series of corrugated, corrosion-resistant stainless steel plates, which optimise the transfer of heat between the primary circuit and the domestic hot water feed, or secondary circuit.

There is not usually a problem with scale because the primary and secondary channels alternate throughout the width of the pack of plates; this gives very good, even heat transfer – unlike direct-fired units or calorifiers, which generally have very high film-surface temperatures that lead to scale precipitating out. Water is continually moving through the PHE because of the circulation pumps or a demand for hot water, and there is the tendency for the plates to flex under different load conditions. All of this helps combat the possibility of scale occurring.

Pressure drops are generally around 30 to 40Kpa on both sides of the PHE and can be reduced by adding more plates to give an increased available head from the primary pump or a decreased pressure drop on the secondary side if, for example, the system is tank fed. Energy taken by the pumps is minimal because most are now class A.

The plates will take up to about 400ppm total water-hardness factor with no problem,

A Stokvis Econoplate plate heat exchanger

PHEs have been installed in Holiday Inns and at Latimer Place, in Chesham, Buckinghamshire (below)

based on primary temperatures of 8°C and secondary temperatures of 6°C. Water softening is a good idea because it would ensure no scale problems. On the primary side, the water should be free from debris and dosed, and strainers should be incorporated.

PHEs instantaneously generate hot water at the required temperature, with flow rates of hundreds of litres per minute. So large hotels and conference centres, where hundreds of people may be showering or bathing over a short time-span, will still have sufficient supply. Even in industrial applications, plate heat exchangers successfully meet very high expectations for the provision of process water.

Stokvis Econoplate PHEs feature factory-fitted primary pumps and fast-responding three- or four-port valves on the primary circuit. There is also a bespoke proportional integral derivative (PID) controller that monitors the secondary water temperature and regulates the motorised valves. The equipment can be readily linked into the building management system.

Despite the depth of knowledge on Legionella nowadays, there remains a risk to health when storing hot water. Choosing to use PHEs to generate instantaneous hot water overcomes the danger associated with storage vessels that have a temperature gradient from the bottom to the top of the vessel. Raising the temperature above 6°C with a PHE is not required as often as storage vessels.

Solar thermal installations have become popular in recent years. On a domestic scale, the solar gain is normally delivered to a twin coil cylinder. For commercial applications, however, we would generally recommend using the output from the collectors as a solar pre-heat arrangement, preheating the water in a vessel from which the water is then fed through a PHE to 'top up' the temperature to the required level for delivery.

Whatever the type of building, or the occupant's business activity, modulating, low-water-content gas boilers – combined with compact modulating low-water-content PHEs – can meet the hot water demand reliably, safely and economically. **CJ**

Wokefield Park, in Reading, Berkshire, has PHEs

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

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

Applying combined heat and power (CHP) to reduce CO_2 emissions and operating costs for the supply of domestic hot water

This module examines the application of natural gas-fired CHP for low carbon energy solutions

The long-term (EU-driven) UK goal is to achieve a reduction in greenhouse gas emissions of 80-95% by 2050, compared with 1990 levels – as defined by the Energy Roadmap 2050.[1] The popular expectation is that the 'decarbonised grid' will supply the energy source to heat and power buildings with a substantially reduced environmental impact. However, the UK and the wider EU are still many years away from reaching this ambitious target.

Pragmatically, systems that are being engineered today to produce energy for buildings over the next 20 to 30 years must maximise the use of dwindling sources of fossil fuels to provide reliable and efficient heat and electrical power, while – importantly – minimising the environmental impact, as well as ensuring value for money.

This CPD will consider the application of natural gas-fired combined heat and power (CHP) as a means of delivering part of this low carbon solution.

It is the EU Energy Efficiency Directive (EED)[2] that set national energy saving expectations – as well as ambitious levels for building refurbishment, and so links into the provisions of the Energy Performance of Buildings Directive (EPBD). The EED is the directive that determines energy consumption targets subsequently set by the UK and other EU member states.

The EED set in motion the building-related legislation that is attempting to improve the performance of buildings, including: building energy auditing; guidelines and performance certification; accreditation schemes for auditors and providers of energy services, managers and installers; creating incentives and funding mechanisms for building operators; metering and billing improvements; promotion of the energy services market; and the imperative that the public sector should purchase energy efficient products, services and buildings.

The recent launch of the *EU Strategy on Heating and Cooling*[3] highlighted that almost half of the EU's buildings still have individual boilers that were installed before 1992, with efficiency of 60% or less.

In 2014[4], the European Commission assessed the progress of EU member states towards the 2020 target of 20% energy savings. Although the headline was encouraging – with estimates that the EU will achieve energy savings of around 18-19% by then – it was noted that about a third of the progress towards the 2020 target was likely to be caused by lower than expected growth resulting from the global financial downturn.

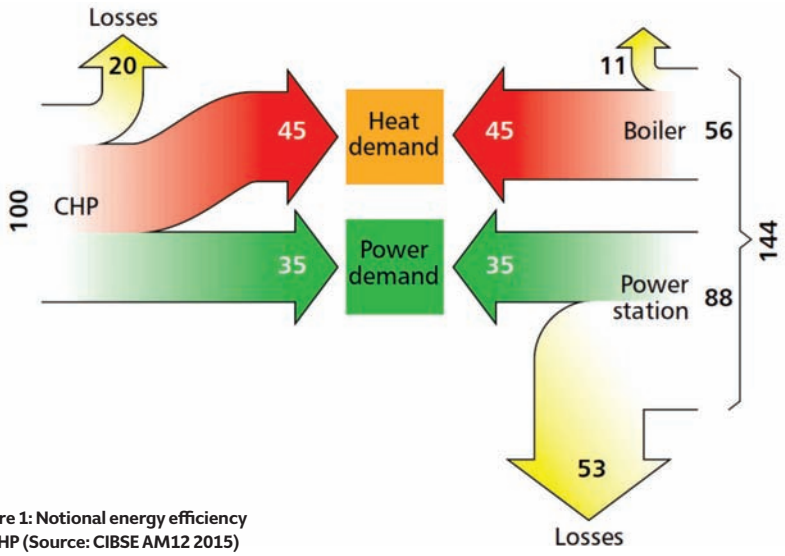


Figure 1: Notional energy efficiency of CHP (Source: CIBSE AM12 2015)

It proclaimed starkly that there should be no complacency about reaching the 20% target, and that the efforts required to achieve targets for the period after 2020 should not be underestimated.

CHP is recognised by the recent EU Strategy on Heating and Cooling as capable of delivering significant energy and CO_2 savings compared with separate generation of heat and power – saving money, while also ensuring a stable and reliable heat and electricity supply.

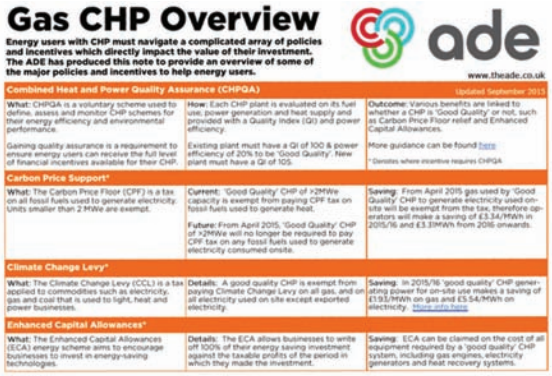
The EED provisions (under article 14) explicitly require that each member state should have undertaken an assessment of the potential for high-efficiency cogeneration (combined heat and power) by 2015. The UK's report, required under EED article 14, was published in December 2015 – *the National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK*.[5] It concluded that to achieve the energy goals, significant investments need to be made in new low carbon technologies, renewable energy, energy efficiency and grid infrastructure.

Combined heat and power

More than 70% of heating in the UK is supplied by conventional oil and gas boilers.[5] CHP in commercial buildings is likely to require more capital expense, and would normally operate alongside other boiler plant, generating heat to produce hot water for space heating or potable hot water. Combining the CHP with some form of thermal storage will increase the efficiency of CHP, as excess heat production can be stored while electricity is being generated.

Ideally, the majority of the annual heat demand would be generated by the CHP plant, while the additional boilers would be used to meet peak demand, and for periods when the CHP unit is not operating. CHP units may, on a relatively small scale, supply single buildings or, on a larger scale, supply a number of buildings in a development or through a community heating system. The most commonly used fuel is natural gas, which can be used in spark-ignition gas engines, micro-turbines, or gas turbines in open-cycle or combined-cycle systems.[6]

When comparing the effectiveness of CHP with using grid-supplied electricity and local heating – for example, gas, oil or electricity – it is practically impossible to predict a definitive performance because of the temporal variations in the production and distribution of primary energy (for example, gas and oil), as well as the generation and distribution of electricity. However, comparisons are made – such as that illustrated in CIBSE's authoritative AM12[7], as shown in Figure 1. This scenario indicates that the primary energy requirement to produce similar amounts of electricity and heat for the end user will consume more primary energy using grid-supplied electricity, plus a local gas-fired boiler (as shown on the right of the diagram) than by using CHP. If there is a simultaneous demand for both heat and power, CHP can consistently deliver energy and carbon savings of around 30%, by reducing the energy lost as waste heat, compared with separate power and heat generation from the same fuel.



Gas CHP Overview

Energy users with CHP must navigate a complicated array of policies and incentives which directly impact the value of their investment. The ADE has produced this note to provide an overview of some of the major policies and incentives to help energy users.

ade

www.theade.co.uk

Combined Heat and Power Quality Assurance (CHPQA)		Updated September 2015
What: CHPQA is a voluntary scheme used to define, assess and monitor CHP schemes for their energy efficiency and environmental performance. Gaining quality assurance is a requirement to ensure energy users can receive the full level of financial incentives available for their CHP.	**How:** Each CHP plant is evaluated on its fuel use, power generation and heat supply and provided with a Quality Index (QI) and power efficiency. Existing plant must have a QI of 100 & power efficiency of 20% to be 'Good Quality'. New plant must have a QI of 105.	**Outcome:** Various benefits are linked to whether a CHP is 'Good Quality' or not, such as Carbon Price Floor relief and Enhanced Capital Allowances. More guidance can be found here * Denotes where incentive requires CHPQA
Carbon Price Support*		
What: The Carbon Price Floor (CPF) is a tax on all fossil fuels used to generate electricity. Units smaller than 2 MWe are exempt.	**Current:** 'Good Quality' CHP of >2MWe capacity is exempt from paying CPF tax on fossil fuels used to generate heat. **Future:** From April 2015, 'Good Quality' CHP of >2MWe will no longer be required to pay CPF tax on any fossil fuels used to generate electricity consumed onsite.	**Saving:** From April 2015 gas used by 'Good Quality' CHP to generate electricity used on-site will be exempt from the tax, therefore operators will make a saving of £3.34/MWh in 2015/16 and £3.31MWh from 2016 onwards.
Climate Change Levy*		
What: The Climate Change Levy (CCL) is a tax applied to commodities such as electricity, gas and coal that is used to light, heat and power businesses.	**Details:** A good quality CHP is exempt from paying Climate Change Levy on all gas, and on all electricity used on site except exported electricity.	**Saving:** In 2015/16 'good quality' CHP generating power for on-site use makes a saving of £1.93/MWh on gas and £5.54/MWh on electricity. More info here
Enhanced Capital Allowances*		
What: The Enhanced Capital Allowances (ECA) energy scheme aims to encourage businesses to invest in energy-saving technologies.	**Details:** The ECA allows businesses to write off 100% of their energy saving investment against the taxable profits of the period in which they made the investment.	**Saving:** ECA can be claimed on the cost of all equipment required by a 'good quality' CHP system, including gas engines, electricity generators and heat recovery systems.

Figure 2: Example guidance sheet on UK policies and incentives (Source: ADE)

The UK's CHP Quality Assurance programme (CHPQA)[8] offers a standardised method of assessing the performance of CHP schemes and, although voluntary, the CHPQA certificate gives evidence of a 'quality index' that is a prerequisite to several governmental financial benefits that may be payable to the CHP operator. This can include Renewable Obligation Certificates, Renewable Heat Incentive, Carbon Price Floor (heat) relief, Enhanced Capital Allowances and preferential business rates.

The only commercial CHP technology supported by the UK's Feed-in Tariff scheme (FiTs) is that fuelled by gas derived from anaerobic digestion. Appropriately installed and operated, domestic micro-CHP with an installed capacity of 2kWe or less may also benefit from FiTs.

It is somewhat complicated to determine the actual benefits that may apply to a particular CHP installation (and the associated legislative responsibilities). The Association for Decentralised Energy has some very informative factsheets at **www.theade.co.uk/incentives_289.html** that offer an overview of some of the major policies and incentives affecting gas, renewable and micro-CHP.

The CHPQA certification assures 'good-quality CHP' – an energy-efficient technology that uses less fuel in total than the alternative methods of separately generating heat by conventional boilers and electricity in conventional thermal power stations.

For small-scale CHP that produces less that 1MWe – such as would be applied in buildings and village-size developments – the CHP needs to perform at least as well as the EU-harmonised efficiency reference values for separate production of electricity and heat. These harmonised values are used to set the benchmark for the CHPQA performance index. They were slightly updated[9] by the EU recently, and the CHPQA requirements will be modified accordingly.

The 2013 Non-Domestic Building Services Compliance Guide, which includes supporting information for the England Building Regulations, requires that CHP systems must have a minimum CHPQA quality index of 105, and power efficiency greater than 20%. The CHP must operate as the lead heat generator, and metering is required to measure hours run, electricity generated and fuel supplied to the CHP unit.

For compliance, the CHP plant should be normally sized so that it supplies at least 45% of the annual total heating demand – that is, space heating, domestic hot water heating and process heating. When applied to community heating systems, CHP may be used as a main or supplementary heat source. The compliance guide details a procedure to determine the carbon dioxide emission rate for a new building

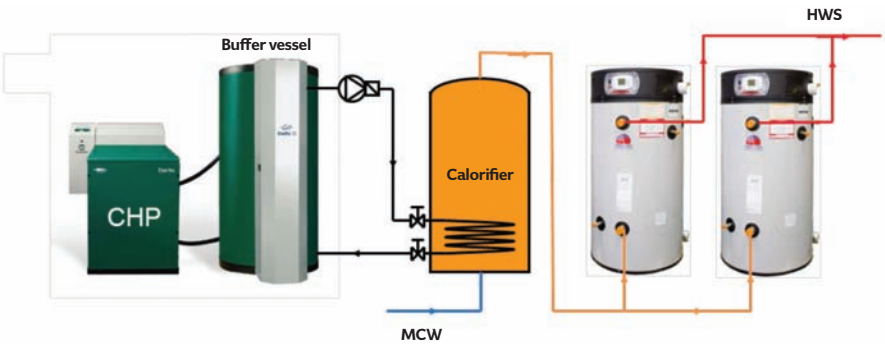


Figure 3: Outline schematic of a CHP providing heat for domestic hot water in conjunction with direct-fired water heaters (Source: Senertec and Andrews)

so that it can be used to show compliance with the Building Regulations.

An example of CHP application

UK local authority planning requirements demand buildings have a proportion of their energy derived from some form of renewable or low carbon technology. Manufacturers are able to offer support not only in supplying products such as solar thermal solutions, heat pumps and CHP units, but also in integrating the equipment with more traditional condensing boilers and direct-fired water heaters.

An application that has been applied in both the UK and Europe is combining CHP with direct gas-fired water heaters, as illustrated in Figure 2. The indirect calorifier is the heat interface between the CHP and the secondary direct-fired water heaters. The calorifier should be large enough to store the CHP heat output during times of low water demand, and it must be able to guarantee full flow of domestic hot water at peak demand.

At the core of the CHP appliance is either an internal combustion engine or gas turbine. The CHP units are heat-led devices, so the thermal output should be selected to match the base heating load of the building, system or process to maximise the annual running period (typically 5,000 to 6,000 hours) and so the economic and environmental benefits. The base electrical load should be carefully considered to minimise exporting electricity to the grid as, in the UK, there is currently little – or no – financial incentive in doing so.

Systems, driven by 'prime movers' – as in the example in Figure 4 and, more generically, in Figure 5 – will reduce the building's consumption of grid-supplied electricity and displace boiler fuel. This particular unit produces an electrical output of around 5kWe and heat output of 12.5kWt and, if operating for around 5,000 hours a year, would reduce annual carbon dioxide emissions by approximately 5,000kg – as well as reducing operating costs.

Typically, the CHP is sized to meet the base load of the building system so that the unit is running as much as possible, and in many applications this base load will be the building's domestic hot water requirement.

Long-term decarbonisation of the electricity grid will mean that, over time, CHP systems will save less CO_2, as they will be competing with lower carbon grid electricity. However, natural gas-fired CHP with efficiencies greater than 20% electricity and 60% thermal will still result in CO_2 savings, as long as unabated gas-fired power stations are still operating on the system.[7]

It is possible that the gas supply will also be decarbonised through the injection of biomethane, which may offset some of the reductions in CO_2 savings. CHP would make better use of this renewable energy.[7]

In the longer term, beyond 2030, it may be necessary to move away from the small-scale natural gas-fired plant to the use of renewable fuels or extraction of heat from major power stations, together with the greater use of district heating.[8]

However, in the foreseeable future, correctly applied CHP can deliver systems that produce less operational CO_2 and reduce energy costs compared with buildings that are powered by grid-supplied electricity and heated by natural-gas condensing boilers.

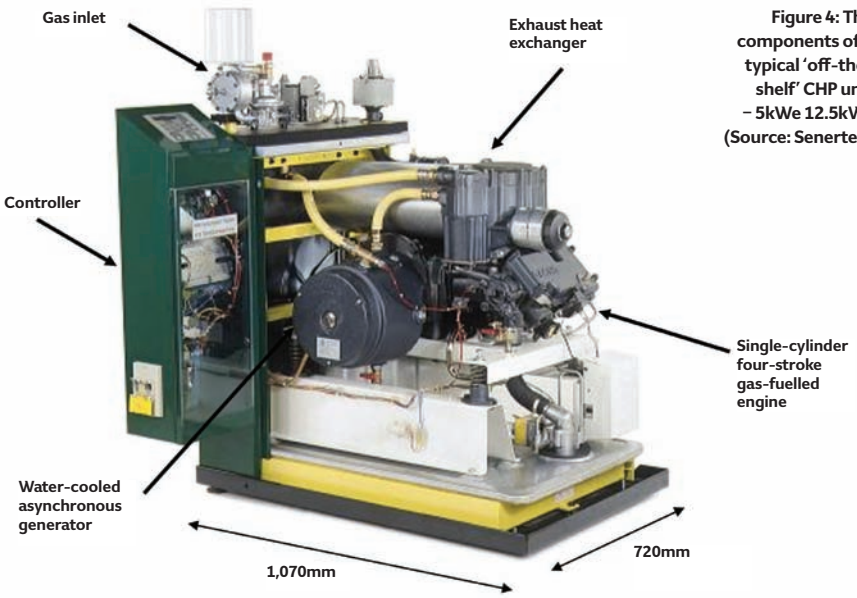


Figure 4: The components of a typical 'off-the-shelf' CHP unit – 5kWe 12.5kWt (Source: Senertec)

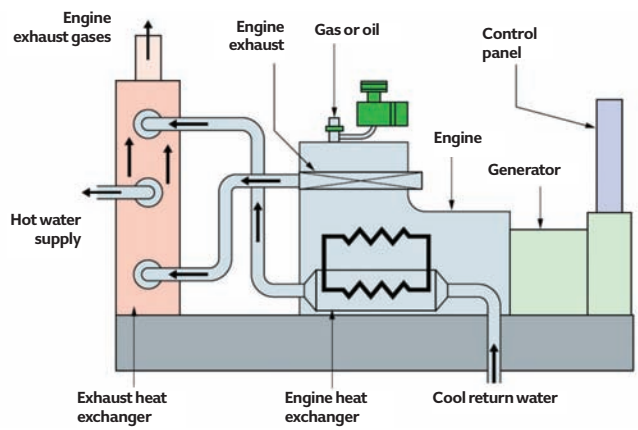


Figure 5: The simplified components of a mini-CHP (Source: CIBSE AM12)

Further reading:

CIBSE AM12 *Small-scale CHP for Buildings*, 2013.
BESA Good Practice Guide TR37 *Installation of Combined Heat and Power*, 2015.
The Local Government Association CHP page: **http://bit.ly/LocalGovCHP**

References:

1 **www.roadmap2050.eu/** accessed 4 March 2016.

2 EED, Directive 2012/27/EU, **https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive** accessed 4 March 2016.

3 *An EU strategy on heating and cooling*, EC SWD(2016) 24 final, February 2016.

4 *Energy efficiency and its contribution to energy security and the 2030 framework for climate and energy policy*, communication from the EC to the European Parliament and the Council, July 2014.

5 *National comprehensive assessment of the potential for combined heat and power and district heating and cooling in the UK*, Ricardo-AEA for the Department of Energy and Climate Change (DECC), December 2015.

6 Non-domestic building services compliance guide: 2013 edition.

7 CIBSE AM12, *Combined heat and power for buildings*, CIBSE 2013.

8 **www.gov.uk/guidance/combined-heat-power-quality-assurance-programme** accessed 4 March 2016.

9 **www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/actes_delegues/2015/06863/COM_ADL(2015)06863(ANN)_EN.pdf** accessed 4 March 2016.

Turn over page to complete module

Module 92

April 2016

ANDREWS WATER HEATERS

1. Approximately what proportion of individual boilers already installed in the EU are thought to have an efficiency of 60% or less?

☐ A Almost 5%

☐ B Almost 10%

☐ C Almost 25%

☐ D Almost 50%

☐ E Almost 75%

2. What proportion of heating in the UK is provided by conventional oil and gas boilers?

☐ A 0-10%

☐ B 10-30%

☐ C 30-50%

☐ D 50-70%

☐ E 70+%

3. What size of natural gas CHP can currently attract FiTs?

☐ A <2kWe

☐ B 2 to 20kWe

☐ C 20 to 200kWe

☐ D 200kWe to 1MWe

☐ E >1MWe

4. What minimum proportion of the annual total heating demand should CHP supply (where installed) to comply with the provisions of the Building Regulations in England?

☐ A 5%

☐ B 15%

☐ C 30%

☐ D 45%

☐ E 60%

5. In the example CHP application, if it were operating for 5,000 hours per year, what approximate saving in carbon dioxide emissions would there be?

☐ A 1,000kg per year

☐ B 3,000kg per year

☐ C 5,000kg per year

☐ D 7,000kg per year

☐ E 9,000kg per year

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Alternatively, you can fill in this page and post it to:
N Hurley, CIBSE, 222 Balham High Road, London, SW12 9BS

Replacement simplified with Grundfos Product Center

The Grundfos Product Center is now well established as the 'go to' pump-selection tool for an increasing number of industry professionals. Much thought and consideration has gone into the redesign of the Product Center to develop a tool that makes choosing the right pump solution as easy as possible.

Selection is also easy when a replacement pump is required. Simply log onto the Product Center and select the 'replacement' option on the home page. Either enter the name of the old pump into the 'Quick Search' field, or enter further data into the 'Classic Search' field. The Product Center will then display the top three replacement pump choices. The selection can be filtered by purchase price, energy consumption or total life-cycle costs.

Additional requirements – such as fluid type and evaluation criteria – provide additional filtering options to ensure that the best pump-replacement choice is there whenever you need it.

● **Call 01525 850 000, email grundfosuk@grundfos.com or visit www.grundfos.co.uk**

Focus Point adds AET fantiles to underfloor HVAC system

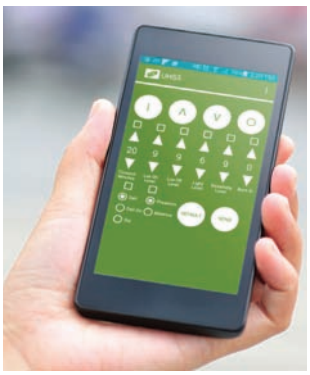
AET Flexible Space has supplied its fan terminal units, known as 'fantiles', to an existing underfloor system at Focus Point, on the Caledonian Road, London.

Part of the Regent Quarter, the building's existing system is a York Flexsys installation – equipment that is no longer available in the UK.

AET Flexible Space helped with optimising the system as part of a refurbishment programme, and enhanced the air conditioning to provide more comfort and more control.

● **Call 01342 310 400, email lucy@flexiblespace.com or visit www.flexiblespace.com**

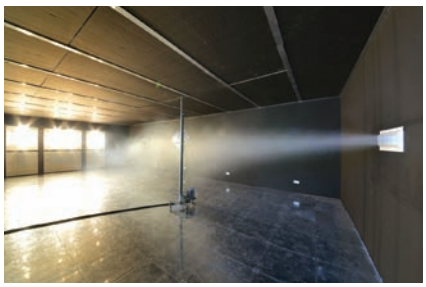
CP Electronics launches smartphone apps for lighting controls



CP Electronics, designer and manufacturer of energy-saving lighting controls, has announced the launch of its first range of smartphone apps. These will enable contractors and end users to control lighting remotely.

Suitable for infrared-enabled mobile phones working on Android 4.1 'Jelly Bean' and above, the UHS7 and UHS5 apps allow users to raise and lower lighting levels, turn lights on and off, and select scenes. The apps are available from Google Play Store.

● **Call +44 (0)333 900 0671 or visit www.cpelectronics.co.uk**



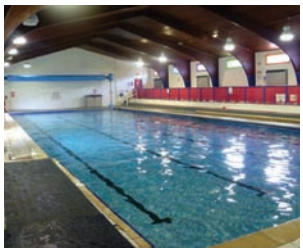
Gilberts helps students get 'hands on' to improve employment prospects

Second-year full-time, and third-year part-time, undergraduates reading for a BEng (Hons) in building services and sustainable engineering at University of Central Lancashire made a visit to Gilberts (Blackpool) recently.

Hosted by Gilberts' technical director, Roy Jones, the visit demonstrated the practical element of the students' mechanical services design module, and enabled them to experience, first hand, the processes involved in modern ventilation strategy. The visit included a factory tour and a technical seminar.

● **Call 01253 766 911 or email info@gilbertsblackpool.com**

New super-condensing water heater for leisure centre



Atlantic Boilers has installed a super-condensing water heater at Whitworth Leisure Centre, Rochdale, which has two swimming pools and a fitness suite that require constant hot water for showers.

Atlantic's E-Condense 450l/55kW water heater, with serpentine flue, produces 920 litres per hour of water at 60˚C with a consistent super efficiency of 97% GCV (107% NCV).

● **Call 0161 621 5960, email nabeela@atlanticboilers.com or visit www.atlanticboilers.com**

How does Hamworthy Heating's new boiler stack up?

Hamworthy Heating has launched its latest British-manufactured condensing boiler range.

The Wessex ModuMax mk3 boiler builds on the heritage of a range that has been in production for more than 10 years. However, it brings it up to date with enhanced built-in controls, 40°C ΔT optimisation, and a 10-year warranty on the primary heat cell.

The vertically stacking boiler offers close load matching, sits on a small footprint and can operate up to 40°C differential temperatures.

● **Call 01202 662 510 or email pr@hamworthy-heating.com**

HygroMatik helps create the perfect environment for wine connoisseurs

A growing number of wine enthusiasts is driving the trend for wine banks with optimal storage conditions. HygroMatik has recently been specified for the WineBank, where more than 24,000 corked wine bottles are stored.

The brief was to maintain ideal temperature and humidity levels, while adhering to the interior design. HygroMatik installed the MS10 Comfort MiniSteam, which can be operated with drinking water to produce pure, mineral-free steam, plus two humidification units.

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

NABIC: a comprehensive range of safety and control valves

NABIC has long been recognised for its commercial and industrial hot-water applications. Its valves, available in gun-metal and stainless steel, are ideal for hot-water supply, heating, pump relief, bypass relief, and outside installation, as well as for use with difficult gases and liquids.

All valves are manufactured in the UK, and pressure-set to customer requirements. Now, for the first time, the valves are also available to buy online, direct from the manufacturer, via a fast-track, next-day service.

● **Call 01462 443 278 or visit www.nabicvalves.com**

Jaga case study – Kenilworth Cottage

The residents of Kenilworth Cottage, in Cheltenham, faced challenges when selecting a living-room radiator, because of the large French windows and an awkwardly placed old radiator.

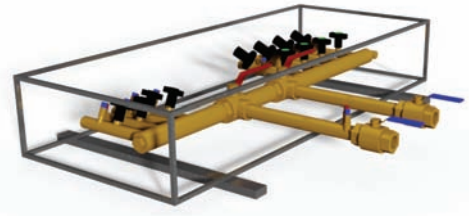
After discovering trench heating, the homeowners settled on the Jaga Mini Canal, which creates convection currents to mitigate heat loss.

Installed in unobtrusive floor alcoves, available from just 90mm deep, the heat emitter is hidden under roll-up grilles, and features Jaga's low-H_2O heat emitters that reduce energy costs significantly.

● **Call 01531 631 533, email jaga@jaga.co.uk or visit www.jaga.co.uk**

Marflow Hydronics enables new product downloads

Marflow Hydronics has developed its website to allow customers to download relevant technical information, including BIM models, via a new product downloads section.



BIM Level 2 will be the new requirement for central government contracts from April 2016. As the move towards complete BIM compliance gets closer every day, Marflow Hydronics is dedicated to providing customers with the information they need.

All product pages can be captured in PDF format and used as a data sheet.

● **Visit www.marflowhydronics.co.uk**

Lochinvar keeps hot water flowing in Sky Garden

Boiler and water heater manufacturer Lochinvar is supplying hot water to two restaurants hovering over London, in the Sky Garden at the top of 20 Fenchurch Street.

The building, known as the 'Walkie Talkie' – the fifth-highest in the capital, at 160m – cost £200m to build. The glazed sky deck is open to the public and contains the highest landscaped garden in Europe.

The Fenchurch Restaurant and Darwin Brasserie, managed by Rhubarb, cater for 750 diners a day, three times the number first anticipated.

However, the hot water required for washing up and cleaning – and for the toilets – has continued to flow thanks to the use of a Lochinvar 150kW LOK packaged plate heat exchanger (PHE) and 500 litre storage vessel.

While the curved upper floors of the landmark building are extremely spacious, conditions are much more cramped in the plantroom. Because of the restricted space, an indirect hot water system – drawing heat from the landlord's central boilers and primary LTHW service – was the solution.

● **Visit www.lochinvar.ltd.uk**

London icon uses Kooltherm FM pipe insulation

Nicknamed the 'Walkie-Talkie', 20 Fenchurch Street, London, features 680,000ft² of office space and has a BREEAM Excellent rating.

To help reduce heat transference from service pipework within the building, 20,000 linear metres of Kingspan Kooltherm FM pipe insulation were installed, to save vital service space and contribute to energy requirements.

The system has an aged thermal conductivity as low as 0.025 W/m·K and holds a BRE Green Guide rating of A+.

● **Call 01544 388 601, email info@kingspaninsulation.co.uk or visit www.kingspanindustrialinsulation.com**

Kingspan delivers top service

The Kingspan KoolDuct system is a premium choice for insulated ductwork. To ensure energy performance and streamlined installations, Kingspan Insulation has now announced its first Kingspan KoolDuct Delivery Partners: CG3, GB Air Solutions, Pascal Air, Sterling Thermal, Technicool, and West Mercia Air.

These experienced partner firms have been selected based on their extensive industry knowledge. They have undergone further training from Kingspan Insulation personnel, ensuring the best possible service on every installation.

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

Panasonic generates significant savings in restored water tower

An abandoned water tower in Harrogate, Yorkshire, has been converted into a family home. Sustainability and energy efficiency were at the heart of the project, and an air source heat pump from Panasonic was chosen to provide a low-carbon heating and hot-water solution.

Cumbria-based renewable heating firm Heacol specified a Panasonic Aquarea T-CAP heat pump to deliver the efficient solution and capacity needed to heat the large home. The T-CAP works well with underfloor heating, which was included in the project.

● **Visit www.aircon.panasonic.eu**

Sea Containers House goes modular with Wieland Electric

Metalynx2, Wieland Electric's popular modular wiring system, has been used as part of the refurbishment of Sea Containers House, on the south bank of the River Thames in London.

The system was specified and installed by mechanical and electrical contractors Phoenix ME. It comes pre-wired and pre-tested, so allows for quick installation when it arrives on site. The fast installation time allowed Phoenix ME to meet the tight deadlines on the project.

The building, named after a global shipping conglomerate that occupied it for several decades, now houses a luxury hotel and 350,000ft^2 of office accommodation.

● **Call 01483 531 213 or visit www.wieland.co.uk**

Ideal Commercial Boilers appoints new business development manager

British manufacturer Ideal Commercial Boilers has appointed Paul Ballard as business development manager. Based in Letchworth, Ballard's territories include Oxford, Slough and areas of London above the Thames, barring the 'E' postcode area.

A keen motorsport enthusiast, Ballard enjoys the challenge of driving Ideal's business forward and further strengthening its sales force in this busy region.

He joined Ideal Commercial Boilers in September 2015 and is responsible for liaising with a wide range of the firm's customers.

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

Discreet ventilation crucial for RIBA award winner

A discreet, but effective ventilation system was a key part of the design for the revolutionary educational building that won this year's RIBA North West Award.

The new St John Bosco Arts College state secondary school was designed by BDP, and built by Vinci Construction, as a massive hangar-style, open-plan facility.

The large space presented challenges to the ventilation designers within the overall vision of minimal physical structures, and the team turned to Ruskin Air Management.

Ruskin's FlowBar Jet Throw linear diffuser is able to ventilate very large spaces, but does not have the unsightly appearance of a jet nozzle. It can be plastered into the walls, ensuring subtle lines that can be a feature of the architect's interior design without any loss of ventilation performance.

The FlowBar diffusers, manufactured in the UK by Air Diffusion, are suitable for either ceiling or sidewall applications, and available in straight lines or curves.

● **Visit www.ruskinuk.co.uk**

Pegler Yorkshire launches reassurance solution

Pegler Yorkshire supports contractors far beyond product supply. Its Warranty Plus initiative was created after in-depth research showed a need for a warranty on a complete system, rather than on individual components.

Warranty Plus took two years to develop, combines 13 brands – including XPress, Tectite, Prestex and Terrier – and is designed to ensure more efficient installations, as well as provide reassurance for years to come.

The three-stage process offers support for projects of more than £250,000, and is backed by a maintenance programme.

● **Call 01302 560 560, email brochures@pegleryorkshire.co.uk or visit www.pegleryorkshire.co.uk**

Warranty Plus

Rehau launches new virtual brochure library

Heating and renewables specialist Rehau has produced a new version of its user-friendly 'docs' app, which specifiers, consultants and contractors can use to access product and technical information on their mobiles and tablets.

The app is available to download from the App Store. Users can create their own virtual library of Rehau brochures and specification guides, which they can access instantly at any time. They can also personalise their library, choosing from Rehau's many product areas, including district heating, ground source energy solutions and sub-surface heating and cooling.

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

Liverpool City Council installs Remeha boilers throughout St George's Hall

Liverpool City Council has installed four Remeha Gas 210 Eco Pro condensing boilers in the north plantroom of the city's St George's Hall, to achieve more reliable, energy-efficient heating. With the addition of these high-performance boilers, the council has standardised the heating equipment at the hall, reducing energy usage, carbon emissions and maintenance costs simultaneously.

Ray Black, from the council's plant and maintenance unit, said: 'Remeha boilers are popular with our engineers because they are easy to install and maintain, and outstandingly reliable. The support we have received from the Remeha service team has been equally impressive.'

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

Marflow Hydronics sets date for PICV CPD

Marflow Hydronics has scheduled a new date for its CPD training course on pressure independent control valves (PICVs).

The CPD course is being held in Birmingham on 4 May and is free to attend.

The half-day session will provide delegates with knowledge of how PICVs work, innovative pipe layouts, and how to make systems more economical, including the introduction of electronic balancing.

It is aimed at consultants, designers, specifiers and key influencers. Places are limited, so registration is recommended.

Call 0121 358 2012, email training@marflow.co.uk or visit www.marflowhydronics.co.uk/events

A new generation of Stannah Piccolo – one of its best lifts just got better

Looks like a passenger lift? Check. Functions like a passenger lift? Check. All the interior options of a passenger lift? No problem.

While, technically, a machinery directive platform lift, Stannah's Piccolo looks just like a passenger lift, with sliding doors, and fully automatic cabin and landing controls.

It has a compact shaft size, minimal pit and headroom, and use of single-phase power supply – so is the passenger lift your project needs. It is a lift for passengers, that isn't a passenger lift.

Call 01264 339090, email liftsales@stannah.co.uk or visit www.stannahlifts.co.uk

Panasonic updates its Etherea air conditioning range

Panasonic has updated its Etherea range with a new line of products. The new Z and XZ domestic air conditioning units are a new design: sleek, compact and modern, suitable for any interior. They are also the first air conditioning products from Panasonic that have been fully optimised to contain the R32 refrigerant, offering the most efficient performance and, so, are more environmentally friendly than ever before. Operating at an incredibly quiet 19dB(A) and with an efficiency rating of A+++/A++, the new range of Etherea air conditioning units offer exceptional performance without sacrificing efficiency or end user comfort.

Visit www.aircon.panasonic.eu

Wieland's Metalynx2 brings power to London's Air Street

Wieland Electric's Metalynx2 structured wiring system was the preferred choice when it came to feeding lighting and power cables through the newly refurbished Quadrant 2 building, at 7-9 Air Street, London.

Technical service providers Imtech, which did the electrical work, specified the system because it provides quick and fail-safe installation, using a unique coding system for power distribution.

The system can also be used for HVAC, underfloor power and the integration of lighting controls using LON-, DALI- or KNX-based systems.

Call 01483 531 213 or visit www.wieland.co.uk

PRODUCTS & SERVICES

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

Robur chillers provide comfort cooling at Embassy Gardens, London

Fifty Robur gas-powered chillers have been installed in Embassy Gardens, a multi-functional luxury building at Nine Elms in London, to supply comfort cooling.

More than 1MW of cooling was required for Phase 1 of the project. Faced with a shortage of electrical power, Robur's gas-powered chillers were chosen.

Supplied by ESS, the chillers are mounted on factory-assembled skids – each of which has a 90kW output but require just a 30 Amp single-phase power supply.

Call 020 8641 2346, email info@roburheatpumps.co.uk or visit www.roburheatpumps.co.uk

New industrial air curtain

JS Air Curtains is launching the VCP, a high-performance industrial air curtain for use on warehouse, factory or cold-store doorways.

The VCP air curtain effectively seals an entrance – such as to a loading bay area – with an invisible barrier of air to stop heat escaping and prevent the ingress of cold air.

Fans, combined with a tubular matrix air discharge system, deliver an air speed of 2m/s at floor level, from a mounting height of nine metres. This allows doors to be left open for pedestrian or forklift access without heat loss, resulting in lower energy costs.

Visit www.jsaircurtains.com

Big Foot Systems modernises rooftop support

Big Foot Systems has supplied bespoke support solutions for rooftop plant as part of the refurbishment of a university building. It delivered a non-penetrative, prefabricated rooftop support system that is simple, safe and secure.

The building's 3,500m² roof was suffering from age-related degradation, with water ingress and loss of thermal efficiency. The whole area needed to be reroofed and the mechanical services, from small AHUs and AC equipment to fans and ductwork, replaced.

Call 01323 844 355 or email enquiry@bigfootsupport.com

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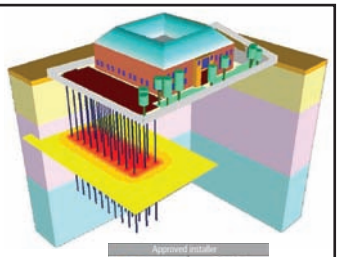

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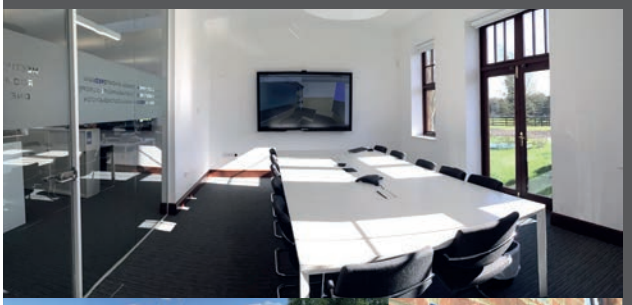

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You will have a minimum of 7 years hands-on industry experience and be degree qualified - but exceptional candidates with shorter experience will be considered. You will take a team role in the design, co-ordination and development of large hotel or data centre projects. Previous experience of working on mission critical systems with excellent communication and commercial awareness skills, together with a proven track record and a robust technical knowledge is essential.

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You will have a minimum of 5 years industry experience, be degree qualified, with the ability to run medium sized projects across a range of sectors including data centre, commercial, hotel and retail. With excellent communication skills and good commercial awareness, you will undertake hands-on design together with a client facing role in the development and co-ordination of engineering projects.

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Principal Public Health Engineer

London, £55 – £60k + bens

My client are an international design consultancy established 25 years that focus on performance and sustainable design of buildings in the commercial, retail, and education sectors. They are looking for an engineer who has extensive experience, leading both projects and teams, to deliver above and below ground design, drainage, water services, and co-ordination of utilities. You will be rewarded with an over market salary, performance bonus, personal development and the opportunity of promotion to Associate. MO3399

Senior Mechanical Engineer

Central London, £38 - £40 per hour

We are working in partnership with one of the oldest building services consultancies in the UK to source a site based Senior Mechanical Engineer. The project is a prestigious new commercial headquarter made up of two buildings. The position is for a 9 month duration and you will be required to liaise with the client and main contractor on services co-ordination. GD3391

Senior Mechanical Engineer

Stevenage, £40 - £50k + bens

A Chartered Engineer with experience in design, feasibility studies, life cycle, planning, and delivery of construction and maintenance projects is required for a UK leading engineering and technical advising company. You will be responsible for supporting the M&E Manager for the region taking full responsibility for leading and managing projects from inception. This is a great opportunity to take the number two role within a major engineering firm. CB3359

Mechanical Design Engineer

Leeds, £30 - £35 per hour

We are working with a mechanical & electrical engineering consultancy that specialises in elegant system design within the built environment. An opportunity has arisen to work on UK and international projects that cover the healthcare and commercial sector. You will be required to carry out all aspects of design, including preparation of technical reports and specifications. KB3385

Senior/Principal Electrical Design Engineer

Manchester, to £50k + bens

Working for an exceptional and well known consultancy on a ten year project focussing on mixed use, high end residential, retail, and commercial sectors. You will manage and lead a team whilst remaining hands on with design and in order to progress to Principal level. You will contribute to a growing department by continually developing yourself and more junior members of the team. Excellent package and support guaranteed. AA3406

CAD Coordinator

London, £22 - £26 per hour

You will be working with a leading M&E firm on an iconic project in the heart of London. The role will require you to carry out technical Revit and CAD operations, coordinating mechanical and electrical engineering designs to produce drawings and detailed models under minimum supervision. Prior knowledge of Revit is not essential but you must be proficient with AutoCAD 2D and 3D. Proven experience working on building services projects is essential to this position. SS3366

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THINKING OUTSIDE THE BOX

Last year's winner of the CIBSE Graduate of the Year Award, **Ryan Rodrigues**, talks about his win, his career goals, and inspiring the new generation of engineers

After graduating with a first-class BEng (Hons) in electrical and electronic engineering from the University of Greenwich in 2010, Ryan Rodrigues worked in the defence industry, in R&D at Thales. He then joined Hurley Palmer Flatt as a graduate engineer, and was put forward for an MSc in building services engineering at London South Bank University. In 2012, he was seconded to UBS's client technical team, working with the bank's EMEA property portfolio, before resuming at Hurley Palmer Flatt.

What was it like to win the CIBSE Graduate of the Year Award?

It was an awe-inspiring experience to hear my name being called and to be awarded the title – particularly because I was up against such talented and bright individuals. Networking with the past award winners made me realise how coveted the title is and it took a few days to truly sink in.

What have you learned from the experience?

The most important thing is a renewed sense of confidence in making the most of every opportunity that comes my way. As someone new to the industry, it can be daunting to ask experienced colleagues questions. The networking skills and ties I have accumulated since the award win have armed me with the tools to strive further.

What has been the highlight?

Without doubt the visit to the ASHRAE Winter Conference, in Orlando, as part of my prize. It brought me to the forefront in terms of exposure within the industry and allowed me to network with ASHRAE and CIBSE members.

> We are fortunate to have access to a wealth of knowledge from experienced colleagues. Ask questions and you will be exposed to alternate ways of solving problems

Discussing topics across continents, where units of measurements and even standard solution practices vary, was a unique experience.

What is the most exciting project you have worked on?

My role as lead electrical engineer on Marble Arch Place – with Rafael Viñoly Architects for Almacantar – has been one of the most exciting projects. This impressive mixed-use development will result in a new landmark building for London, and a striking gateway to the West End once completed in 2020. The scheme includes high-end residential apartments, retail space, commercial offices, a cinema and a leisure centre. I proposed a cutting-edge and robust electrical design for the scheme, which has been a rewarding experience.

What is the most challenging thing about your job?

The construction industry is slow to change, and it takes significant discussions to convince project teams to do things differently. For example, LED lighting and BIM have gained momentum, but there is still hesitation about using them within certain groups – it can often be more profitable to go down the standard route, without thinking outside the box. It can be hard to find the balance between making sustainable profit and pushing the boundaries of building services design.

What are you working on now?

I am carrying out detailed design on a new-build, mixed-use development on King's Road, Chelsea. The scheme will encompass residential apartments, commercial offices, a cinema, a pub and a rooftop bar/restaurant. My involvement varies from preparing tender documentation and drawings, to attending coordination workshops with the wider design team.

What inspired you to become an engineer?

As a kid, I loved taking apart items – from clocks and washing machines to televisions and computers. The curiosity to understand how they worked (much to the horror of my parents) got me interested in engineering.

What advice would you give to a young person considering a career in building services?

Replicate a sponge, soaking up as much information and knowledge as possible. We are fortunate to have access to a wealth of knowledge from experienced colleagues. If you ask questions, you will be exposed to techniques and alternate ways of solving problems. Also, attend site as much as possible, so when you are carrying out a design in the office you can visualise a cable route through a building, instead of just drawing a line on an architect's background.

Has your view of the industry changed since you graduated?

Yes. At university, I felt it was more of an office-based, technical job, where time would be spent getting software to assist me in the design. I have now realised more time is spent in design meetings, coordination workshops and on site visits, bringing the buildings to life.

● The Young Engineers Awards 2016 are open for entries. See page 11 for details

● **RYAN RODRIGUES** is an engineering consultant at Hurley Palmer Flatt

Events & training

NATIONAL EVENTS AND CONFERENCES

CIBSE Technical Symposium
14-15 April, Edinburgh
The 2016 technical symposium will take place at Heriot-Watt University, Edinburgh. Titled 'Integration for whole-life building performance', the symposium will again feature more than 60 papers presented across the two days.
www.cibse.org/symposium

CPD TRAINING

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

Lighting and energy efficiency
14 April, London

Design of heating and chilled water pipe systems
15 April, London

Fire detection and alarm systems for buildings
19 April, London

Building services explained
20-22 April, Manchester

Building drainage explained
21 April, London

Practical controls for HVAC systems
22 April, London

Earthing and bonding systems
22 April, London

Low and zero carbon technologies
26 April, London

Mechanical services explained
26-28 April, Leeds

Practical project management
27 April, London

Energy monitoring and targeting
28 April, London

Building services overview
29 April, London

Energy efficiency building regulations
29 April, London

Implementing ground and water source heat pump schemes
11 May, London

Low carbon buildings for local authorities
11 May, London

Lighting and energy efficiency
12 May, Manchester

Design of ductwork systems
12 May, London

Air conditioning inspection
17 May, Leeds

Air conditioning and cooling systems
18 May, London

Heat networks
18-19 May, London

LCC design and EPC
18-19 May, Newcastle

Building services explained
18-20 May, Exeter

Fire sprinkler systems: Design
20 May, London

Lighting design: Principles and application
20 May, London

ENERGY ASSESSOR TRAINING

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

LCC design and EPC
13-14 April, London

LCC building operations and DEC
26-28 April, London

ESOS training
10 May, London

Introduction to ground and water source heat pump schemes
10 May, London

LCC building operations and DEC
10-12 May, Leeds

ISO 50001 training
24-26 May, London

CIBSE GROUPS, REGIONS AND SOCIETIES

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

West Midlands technical seminar: Cascading and discrimination
6 April, Birmingham
Seminar addresses the co-ordination techniques as specified by BSEN 60947-2.

YEN South West: Do building occupants matter?
6 April, Bristol

HCSW membership briefing, presidential address and AGM
6 April, Epsom

North West AGM
7 April, Manchester

HCNW: AGM – CHP and water source heat pumps, codes CP1 and CP2
7 April, London
Phil Jones, of CIBSE CHP and District heating group, will present on combined heat and power, water source heat pumps and the Codes CP1 and CP2.

NE technical meeting – Edge debate
12 April, Newcastle upon Tyne

East Midlands: AGM
12 April, Nottingham

South West: AGM, President's address and technical seminar
12 April, Bristol

Society of Light and Lighting masterclass
13 April, Edinburgh
Continuing the masterclass series: Inside Out; Light and Architecture.

LuxLive Middle East
13 April, Abu Dhabi

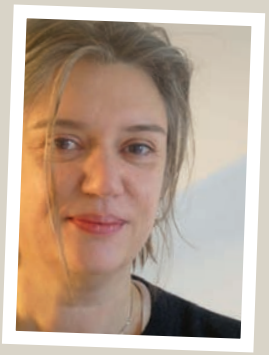
Southern region: AGM and 50 shades of green
14 April, Chichester

SoPHE: Scale control of physical water conditioning and Ion-exchange water softening
14 April, Bristol
Talk by Hydrotec.

South West: Lighting; more psychology and art than science?
19 April, Plymouth

Green Sky Thinking Week: Urban walk with Julie Futcher

April, London



The walk, titled 'Walking among giants', presents a unique view of the City of London through the role of tall buildings in creating distinct microclimates, and offers a novel perspective on the City's dramatic and changing skyline.

The walk takes just under two hours and is a very enjoyable way to learn about the effects of tall buildings on both the public realm and on the energy management of the underlying setting.

The tour aims to disseminate urban climate research to the building and urban design/planning community. It will offer insights into the various urban climate effects from an architect's perspective. The walking tour covers issues associated with the environmental impacts of urban development and the scale and timing of microclimates produced (including the spatial and temporal nature of the different urban heat islands).

For more information, visit **www.greenskythinking.org.uk/index.html**

Henrik Clausen, director of Fagerhult's Lighting Academy in Copenhagen, will present on how lighting affects our lives.

West Midlands: AGM and technical seminar – UNESCO Year of Light summary
20 April, Birmingham

Merseyside and North Wales: AGM and seminar
21 April, Liverpool

Ireland: CPD Radiant heating systems
21 April, Galway

CIBSE UAE: Annual dinner
21 April, Dubai

Hong Kong Chapter: Annual safety conference
22 April, Hong Kong

North East: AGM
26 April, Newcastle

HCNE: AGM
26 April, Brentwood

Ireland: AGM
27 April, Dublin

South Wales: Membership briefing
27 April, Cardiff

Yorkshire: Project fire CPD and AGM
27 April, Leeds

YEN South West: Charity pub quiz
28 April, Bristol

West Midlands: Technical seminar – project presentation E.ON
4 May, Birmingham

Scotland golf championship
28 April, London
Sponsored by Kingspan, with team prizes and networking.

HCNW: Return to King's Cross
TBC, London
A guided tour of St Pancras station by Simon King, Arup's MEP lead designer. Booking essential.

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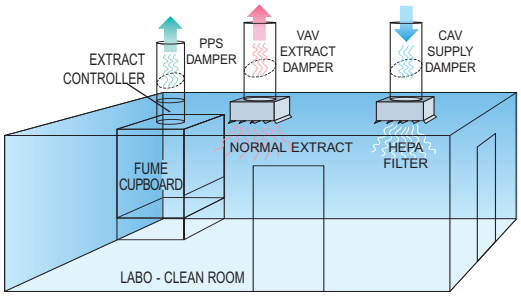

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