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The complex relationship
between retrofit & human health

Mies En Scène

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deep green treatment

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UK EDITION



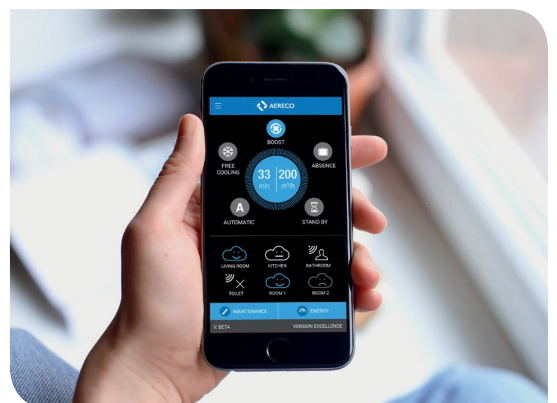
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Cover**Goldsmith Street**

Photo by Jim Stephenson

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Disclaimer: The opinions expressed in Passive House Plus are those of the authors and do not necessarily reflect the views of the publishers.



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editor's letter

ISSUE 32

Publishing a magazine like Passive House Plus is a curious experience – at least in our case. The production team here tend to work remotely, including three of us in two Dublin locations, a deputy editor and reporter in Galway, with other reporters living in places as disparate as Kildare, the Forest of Dean and Paris – not to mention our regular columnists in Sandycove, Cork, Bradford-on-Avon and Milton Keynes. So I rarely get to meet many of my colleagues, let alone our readers. On the occasions that I do manage to extricate myself from my desk to attend a conference or show, I'm taken aback by the contrast between the lot of the publisher and the event organiser: what a crystallising experience it is – for better or worse – to have your entire audience before you.

This contrast is brought into sharp relief when a stranger approaches you at an event and says they enjoy the magazine. At one recent conference, a German architect who moved to Ireland in the 1990s approached me, explaining that she was shocked at the dearth of detailed technical information on construction in Ireland at the time. Then she discovered our former magazine, Construct Ireland, after we launched in 2003, and she's been devotedly reading our magazines ever since. I should get out more.

Usually we don't get to experience that much feedback – positive or negative – from our readers, so self-doubt creeps in and you wonder what impact your work is having. You get the odd hint though. We have a hardcore of extremely loyal advertisers – including four companies who have advertised in all 31 UK editions of Passive House Plus to date, and some companies who have advertised in virtually every Irish edition we've put out for ten years or more. Without that kind of backing and moral support, this magazine frankly wouldn't exist.

But evidently most people aren't prone to reaching out arbitrarily to a stranger like me to

talk about the effect our magazine has on them and their work. So we approached the idea of our first ever reader survey with trepidation. We had been spurred on by our partners in the AECB, who surprised us a couple of years ago with the results of a survey where they asked their members about their impressions of the magazine. The results were generally very positive, with lots of effusive praise. Still, that was a devoted audience of green-minded construction professionals. What would our broader readership think?

We needn't have worried – the results have been almost too positive. A clear picture has emerged – as is revealed in the report on the survey findings on page 13. If these responses are anything to go by, the vast majority of our readers value our work, and our efforts to carefully curate articles and adverts are affecting real decisions on countless construction projects of all shapes and sizes all over the UK and Ireland – and hopefully helping to make as many buildings as possible as sustainable as possible.

We hope this latest issue has a similarly positive affect on you and your work. Among all the latest news, insightful columns and features, we're thrilled to include detailed case studies on four markedly different projects, ranging from the Stirling Prize-winning passive social housing scheme – a combination of words I never expected to hear – adorning our cover, to the bravura deep green retrofit of an architecturally significant oil-age glass box that seems the very definition of hard to treat, to a pair of nearly zero energy homes built using a highly innovative flat pack build system, to an ecological passive house build system manufacturer building their own offices in their own factory. We hope you find all of this as inspiring to read as it was to write about.

Regards,
The editor



International

PASSIVE HOUSE

Association

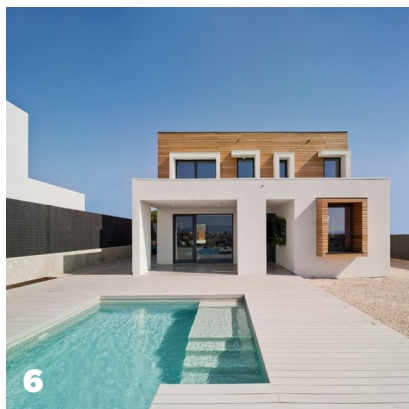


The UK Passive House Organisation

About

Passive House Plus is an official partner magazine of The Association for Environment Conscious Building, The International Passive House Association and The Passivhaus Trust.

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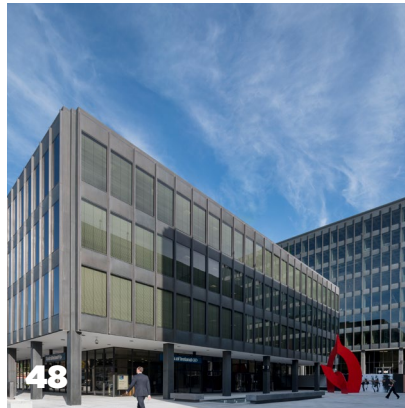
Office Romance

Passive house supplier walks the walk with new office & factory

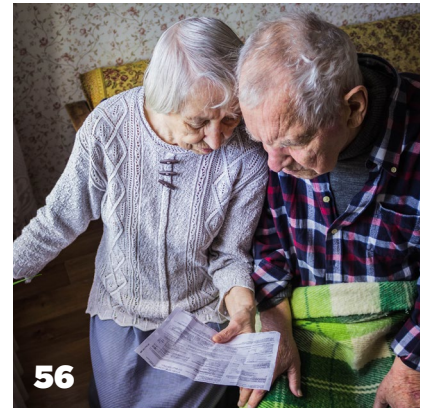
When Welsh sustainable building specialists PYC decided to start making their own timber frames, they got down to work designing and building their own factory. Once that was finished, it was time to test their system on their first order: to build their own passive house certified offices right next door – and to be bold enough to decide not to install central heating.



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Stirling Work

The passive social housing scheme that won British architecture's top award

Early in October, Norwich City Council's Goldsmith Street development became both the first passive house and the first social housing project to win the Stirling Prize, British architecture's most coveted award, with the judges calling it "high-quality architecture in its purest, most environmentally and socially conscious form". Leading building energy expert Dr Peter Rickaby visited the scheme for Passive House Plus to see this ground-breaking project for himself.

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Flat-pack furniture has become a fixture of modern living, but what happens when the same concept is applied to housing – and when the client is an architect seeking to build to passive house and nearly zero energy building levels?

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Iconic Dublin offices get deep green treatment

The deep and comprehensive refurbishment of the Miesian Plaza complex on Dublin's Baggot Street provides a radical blueprint for how to transform mid-20th century city office buildings into comfortable, healthy and super low energy spaces that support sustainable transport and working patterns.

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Doctor's Orders

The complex relationship between energy retrofits & human health

There is no shortage of anecdotal evidence that home energy retrofits, done well, can improve the health of those who receive them — and equally there are horror stories about shoddy upgrades causing damp, mould and illness. But what does the evidence say about how energy upgrades effect occupant health, and what lessons can be learned for the future of how we renovate our homes? Kate de Selincourt reports.

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MARKETPLACE

Keep up with the latest developments from some of the leading companies in sustainable building, including new product innovations, project updates and more.

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In Praise of Impermanence

We hear a lot about the importance of designing our buildings to have a long lifespan, but might there come a time when it actually makes more sense to design buildings to have relatively short lives — and to be easily taken apart and re-purposed in response to a changing climate and society? Toby Cambray, co-founder of Greengauge Building Energy Consultants, ponders the idea of impermanence in construction.

INTERNATIONAL

PASSIVE & ECO BUILDS FROM AROUND THE WORLD



IN BRIEF

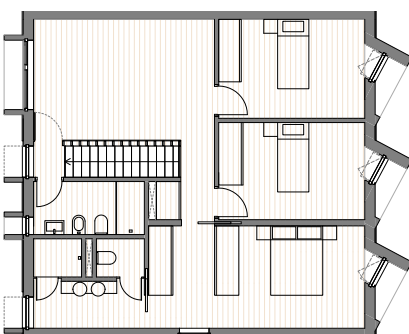
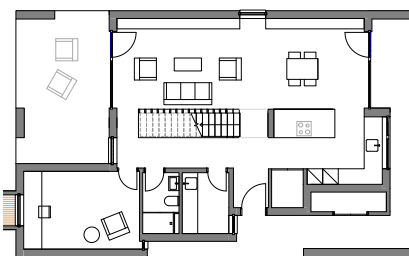
Building: 165 m² detached home

Architect: Zink Arquitectura

Method: Timber frame

Standard: Passive house certified

Photos: David Frutos



CASA PARA ECO, LA ALCAJNA, MURCIA, SPAIN

This gorgeous new home, dubbed Casa para Eco, is the first certified passive house in the region of Murcia in south-east Spain. Built with a timber-frame structure that's insulated with mineral wool, the three-bedroom house manages to be striking yet simple and is a relatively modest 165 m² in size.

Of course, in the hot semi-arid climate of Murcia, keeping cool in summer is just as important as keeping warm in winter, so a combination of overhangs, and recessed and rotated windows, helps to block the hot summer sun, while letting in the lower-angle winter light. Winter temperatures still drop under 5C regularly on winter nights, so the fabric-first approach is crucial for keeping warm too.

"Data from its first year of occupation shows a great level of comfort experienced by its occupants both in winter and summer, with a very low energy

consumption," says project architect Joaquín Ruiz Piñera of Zink Arquitectura.

Ruiz Piñera says he aimed to use natural, low embodied energy, and recycled materials as much as possible — this includes cork insulation in the roof terrace — with the aim of delivering a comfortable, healthy and ecological house that, he says, is "shaped by the sun". The roof also boasts a 2.5kW solar photovoltaic array, while a small air source heat pump covers its mechanical heating and cooling demand.

Inside, the finishes are modern and minimal yet warm and bright, with the striking floating staircase contrasting nicely with warm wood finishes.

And if you're wondering how much energy the small swimming pool uses, it's unheated, simply providing a cool place for a dip on hot days, so the only operational energy used is for its cleaning filter.

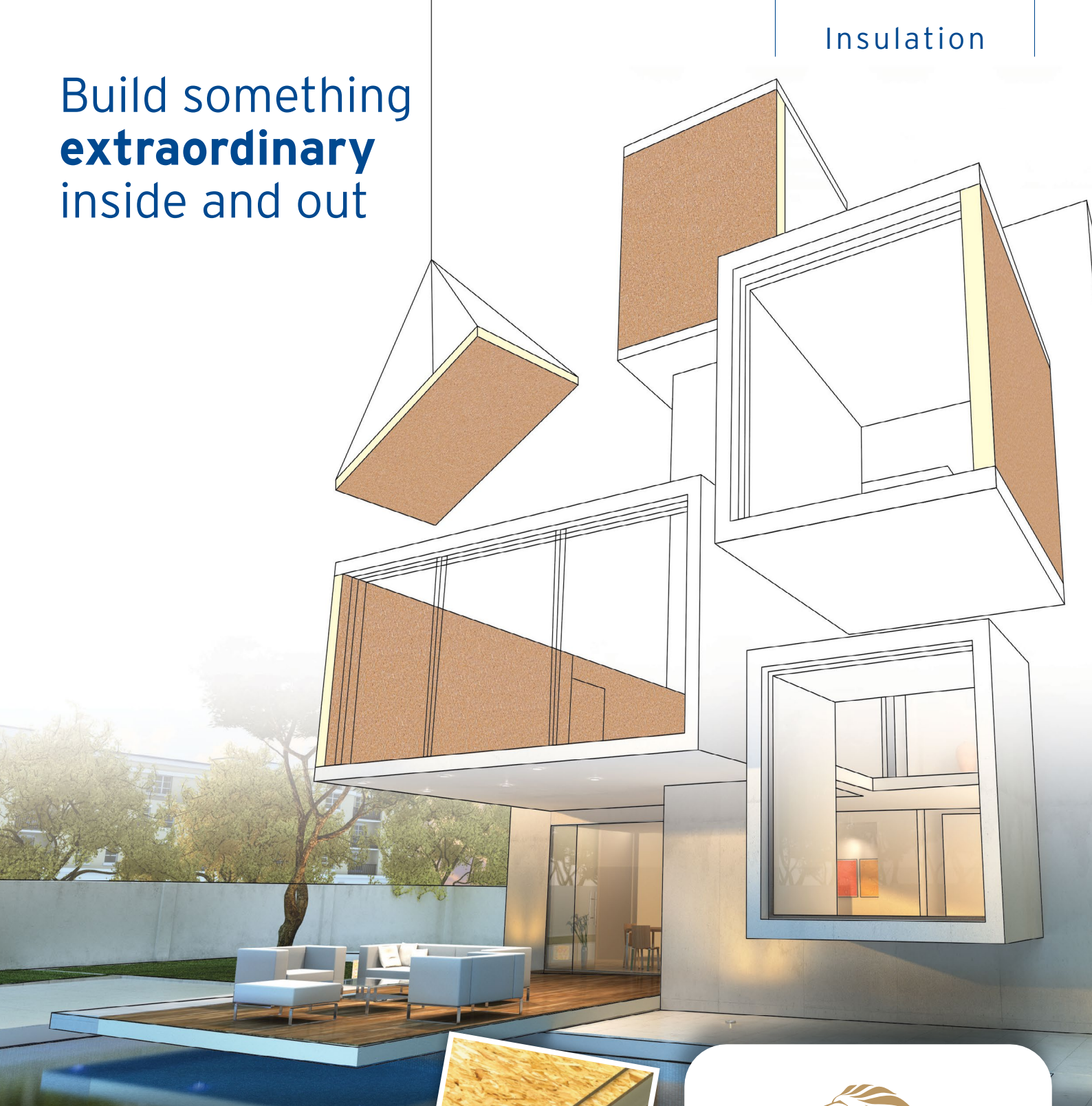
WANT TO KNOW MORE?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie



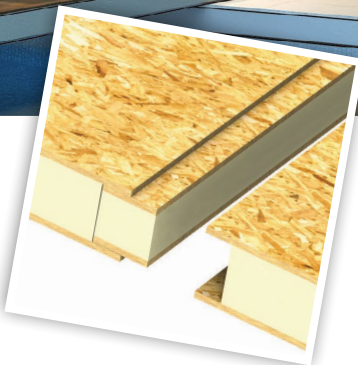
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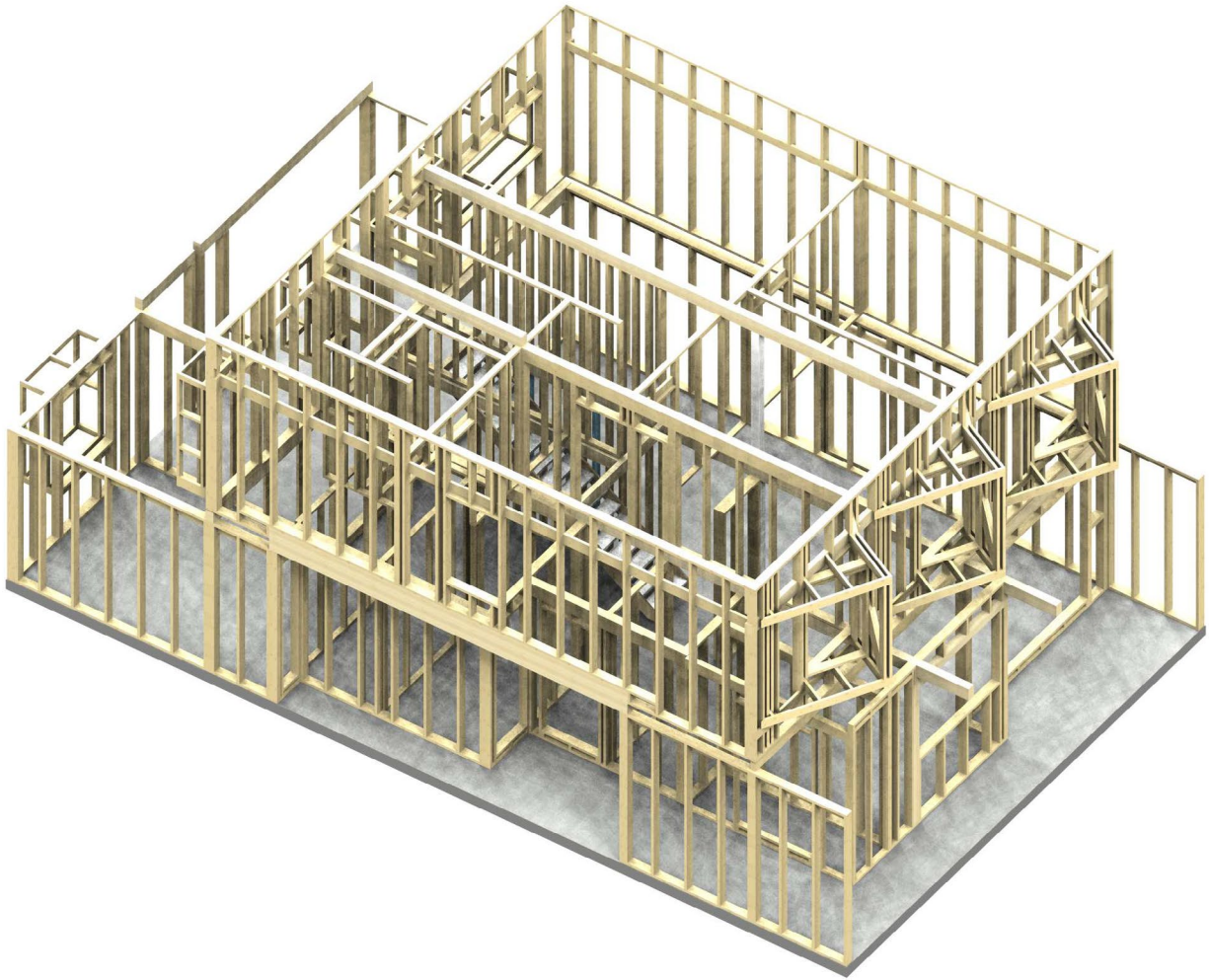
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NEWS

Draft new Part L energy efficiency regulations “disappointing”, critics say

By Kate de Selincourt

Voices from across the construction industry have united in criticising the UK government’s “disappointing” proposals to update the building regulations and progress towards a 2025 “Future Homes Standard” for England.

The proposals, which are out to consultation until 10 January 2020, entail a 30% reduction in emissions, but these can be achieved mainly or even entirely by replacing gas with low carbon services such as heat pumps, with little or no fabric improvement, critics say. The government has proposed an alternative option, entailing more demanding fabric improvements, but with even less drop in overall emissions: only a 20% reduction.

At the recent annual conference of the Good Homes Alliance, Thomas Lefevre from Etude was one of numerous delegates who spoke out about the changes. “It is a very disappointing target. It is much less than we can achieve,” he said, to applause.

Representatives from the Passivhaus Trust, CIBSE, the AECB, the UK Green Building Council, the London Energy Transformation Initiative (LETI) and the Good Homes Alliance have all called for the government to go further now, and move faster to announce its next steps.

CIBSE and LETI both set out their positions in the CIBSE Journal in November. CIBSE technical manager Julie Godefroy wrote that full fabric improvements and decarbonisation of building services should both be brought in right away, as the lower energy demand is, the easier decarbonisation becomes. “[The new Part L should] include the best possible fabric to future-

proof homes, reduce demand, and limit the costs of low-carbon heating,” she wrote.

The London Energy Transition Initiative (LETI) warned that “the proposal ... means you can achieve targets with system upgrades alone”. “If designers changed to a heat pump you could get a higher level of savings with an inferior fabric,” LETI founder Clara Bagenal George wrote.

The Passivhaus Trust also argues that dramatically improving building performance is the only realistic way to achieve net zero carbon, and they warn that this means closing the as-built performance gap (the difference between the amount of energy buildings are designed to consume, and what they end up using in reality), as well as setting more ambitious standards on paper.

The Part L efficiency metric proposed, as of now, requires efficiency improvements only in comparison to a notional building, and ignores how inherently efficient a building is designed to be. This approach is seen as a missed opportunity to make much more effective improvements by taking advantage of the savings from improved form factor and sensibly sized glazing, for example.

Technical director of the Passivhaus Trust, John Palmer, said: “We need to move away from the ‘notional building model’ and adopt a series of definitive energy use intensity targets in kWh/m² per year”. This position is supported by LETI, and CIBSE has also called for a shift towards regulating total operational energy performance, rather than regulated emissions only.

The Ministry of Housing, Communities & Local Government says its aims for the 2025 Future Homes Standard would result in the

average new-build home in 2025 having between 75 and 80% less carbon emissions than one built to current energy efficiency requirements (Approved Document L 2013).

On its website, boiler and heat pump manufacturer Vaillant challenged the government to go further: “We have to ask whether we are challenging ourselves enough,” head of training Mark Wilkins wrote, pointing out that the targets suggested for England for 2025 barely exceeded what Scotland achieved four years ago with their 2015 standard.

However, the government does not even propose to begin work on the 2025 standard until 2021, and does not intend to consult till 2024. John Palmer was one of several at the Good Homes Alliance event who pointed out the need to give industry more notice. “There is no point in telling industry in 2024 what to do in 2025 — they won’t be ready. We need to tell them now.”

Jenny Barker, director of planning for Cherwell District Council, who was responsible for implementation of low-carbon development at Bicester eco town, has extensive experience of getting developers to build to higher energy standards. She too was clear about the need to give industry time. “Strong, clear policy and consistency is required. Time is of the essence because change is slow. I don’t think we can wait five years, we need to do it now.”

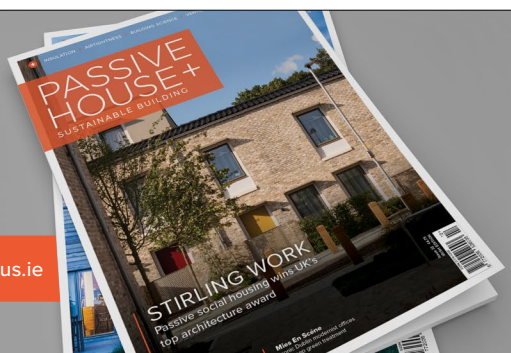
The proposals also include revisions to Part F, and a consultation version of an update of SAP, SAP 10.1. The Passivhaus Trust and AECB local groups are working on responses to the consultation; members of both entities can get in touch to participate. ■

83% of readers

think of the brands that appear regularly in Passive House Plus magazine as some of the main brands involved in sustainable building*

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*source, Passive House Plus UK edition 2019 reader survey



Nine out of ten PH+ readers have made decisions based on articles



Nine out of ten PH+ readers have made decisions based on articles

Nine out of ten readers of Passive House Plus have made decisions on building or upgrading projects in response to articles in the magazine – and nearly eight out of ten in response to adverts – according to the results of a survey of readers of the magazine's UK edition.

Only 6% of surveyed readers bin or recycle the magazine once they're finished with a given issue – with 71% filed away for reference, 6% shared, and 17% left on display. Eighty per cent of respondents read the magazine from cover-to-cover or read most articles and flick through the rest, while 18% read some articles and flick through the rest.

Almost 99% of respondents – 98.8% to be precise – find the magazine's content relevant in light of tightening building standards.

The survey also indicates that the majority of readers are engaging with the magazine's highly targeted advertisers. Over 90% of respondents said the adverts in Passive House Plus are relevant to them, with over 77% having made decisions on projects because of adverts in the magazine.

Seventy-two per cent of respondents pay more attention to ads in Passive House Plus than other magazines, and think a brand looks more credible when it appears in Passive House Plus – while 83% think of

the brands that appear regularly in Passive House Plus as some of the main brands involved in sustainable building.

Thirty-nine per cent of readers are design professionals, 35% are self-builders, 5% are specialist consultants, 5% are contractors or product suppliers, and 6% are property developers or corporate/public sector clients.

Ninety per cent of design professional readers have made decisions on projects in direct response to ads, as have 71% of self-builders. Sixty-one per cent are involved in one-off house projects, 32% in multi-unit housing, 21% in commercial, 16% in public buildings, 18% in educational/healthcare buildings, and 10% in industrial projects. Given that most respondents are industry professionals, the majority are working on several project types.

Thirty-seven per cent of respondents read the magazine from cover to cover, 44% flick through and read most articles, 18% flick through and read some articles, while 2% flick through the magazine but read no articles.

The survey indicated there are 1.99 readers per copy of Passive House Plus. Forty-four per cent of copies are read by one person only – but this may be in part because of how closely they guard it – given that 71% of this cohort of respondents file the magazine away for reference after

reading.

The online survey was conducted from September to October 2019. The survey was promoted via an email newsletter and a separate email to subscribers. 516 responses have been collected by the time this analysis was completed, including 170 from UK-based readers. Note that not all readers answered all questions in the survey – 86% completed the entire survey. The survey also included similarly positive results from Ireland-based respondents – indicating that the Irish edition is also making its mark on the construction practices in Ireland.

Commenting on the results, editor Jeff Colley said: "Passive House Plus is published to meet a very specific need: to provide detailed technical information on how to build quality, sustainable buildings, at a time when the whole construction industry is required by tightening building standards to do precisely that.

"We work hard to help designers and clients to specify the right materials, the right technologies, detailed in the right way, to deliver successful buildings – and to find the right product and service providers to make this happen. Our reader survey shows that our readers – the vast majority of whom are design professionals or self-builders – are responding to adverts and articles in Passive House Plus in exactly the way we would hope." ■

Passive house costs falling, new study finds

New research published by the Passivhaus Trust has shown that the real-terms cost of building to the passive house standard has fallen since the previous study four years ago.

A “best-practice” passive house social residential project might now be achieved at a cost uplift of 8% over a non-passive equivalent – and some projects are already achieving lower costs even than this.

The Trust’s latest research examined cost data from just over a dozen passive house residential developments ranging in size from less than five to over 70 units. Most were constructed for social landlords, with a minority for private sale.

The Trust analysed contract pricing information by element where this was available and found a range of extra-over costs. The Trust was able to identify factors that were associated with lower extra-over costs, including simple form, modest glazing, and an experienced team – in particular, experienced clients.

Taking an ‘ideal’ project based on these extra-over costs, it was calculated that the full extra cost of passive house, to include, structure, insulation, glazing, airtightness, building services, site supervision, airtight testing and certification, could be around £115/m². This is around 8% of the average cost for similar-sized social housing projects in a relatively cost-neutral UK region, as calculated by Taunton-based cost consultants Baker Ruff Hannon.

The project also analysed the full build costs for the projects where this was available. Here a clear trend of cost reduction was seen in the latest costs, versus the costs collected by the Trust in 2015 (costs were corrected for inflation to enable more meaningful comparisons).

While costs of the more expensive projects in each survey were similar, in those in the lower-cost end of their cohort, prices showed a distinct drop.

A similar trend was reported by a single client, Exeter City Living, who have now completed or tendered for 10 passive house projects since their first in 2010. Over the course of several “generations” of procurement, learnings have been fed back in, to simplify and de-risk the projects, resulting in a real terms fall in construction costs of around 20% in that period.

The researchers spoke to a number of designers and contractors in the course of the research, who gave further insights into the way they had controlled costs, and also, the benefits they had been able to gain in their own companies as a result of what they had learned.

One contractor who built two successive passive house projects for the same client, using the same system, told the Trust how experience from their first build had fed back into the second: “For the first project, we had to do remedial work after the air tests on a number of units. We identified some weak points and changed some aspects of the construction for the second project, and had modifications made by our system supplier.

“On our next project, all the units passed first time. The whole build has gone a lot more smoothly.” On another project the quality assurance (QA) process adopted by the contractor led to a significant drop in defects, and now informs all their builds: “Defects and legacy are so frustrating for a contractor – you lose a lot of money and tie good people down going back to sort stuff out. The (QA) sign-off process has been a good lesson and reaped rewards in our business. It has been a good learning process for us.” ■

“Compelling evidence” that Grenfell breached building regulations

By Kate de Selincourt

The judge chairing the Grenfell Inquiry has said there is “compelling evidence” that the refurbishment of the tower was not compliant with the building regulations – and that it would be “an affront to common sense” to suggest otherwise.

The judge, Sir Martin Moore-Bick, also warned building designers and owners not to take testing information and guidance on trust. He warned anyone making decisions about products on high rise buildings to “exercise great care”, and to “scrutinise” manufacturers’ information.

In his report of phase one of the judicial enquiry into the Grenfell fire, published at the end of October, Sir Martin wrote: “The external walls of the building failed to comply with Requirement B4(1) of Schedule 1 to the Building Regulations 2010, in that they did not adequately resist the spread of fire... On the contrary, they actively promoted it.”

He added: “There is compelling evidence that Requirement B4(1) was not met ... It would be an affront to common sense to hold otherwise.” The reason this was allowed to happen was not in the scope of phase one of the enquiry, but will be one of the main questions he would address in phase two, the judge said. “It will be necessary to examine why those who were responsible for the design of the refurbishment considered that the tower would meet that essential requirement,” he added.

Phase one of the enquiry focused on the events of the night of the fire, June 14, 2017, and while much of the report is taken up with the firefighting and rescue operation, the immediate reasons for the scale and speed of the fire itself were also determined. In his report Sir Martin was clear that the aluminium composite material (ACM) cladding panels, and in particular, their polythene cores, were the “principal reason” for the devastating scale of the disaster. He noted that the rapid spread of the fire horizontally and downwards set this fire apart from other tall building fires.

The judge explicitly dismissed arguments of the cladding manufacturer Arconic, who had argued that it was too early to determine why the fire developed so catastrophically. “In its closing statement Arconic argued that the evidence heard in Phase 1 was too provisional in nature to enable any firm conclusions to be drawn about the development of the fire. I do not agree,” he wrote. He also said it was “more likely than not that the presence of PIR and phenolic foam insulation boards behind the ACM panels (and perhaps the EPDM membrane and the Aluglaze window infill panels) contributed to the rate and extent of vertical flame spread, but it is not possible at this stage to quantify the extent of their respective contributions”.

Phase two of the inquiry will look in detail at the regulations, testing regime, and advice and guidance on fire safety of construction and materials. Testing “may be neither as rigorous nor as effectively enforced as it should be,” Sir Martin wrote, adding: “doubts have also arisen about the reliability of the certification of certain materials for use in high-rise buildings”.

This is an extract of a longer report on the Grenfell enquiry, the full version of which is online at www.passivehouseplus.co.uk. ■

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ENVIRONMENTAL AWAKENINGS

Tracing the roots of today's climate activism

While the green wave visible at ballot boxes and street marches in 2019 reflects an apparent escalation in public consciousness on the need for urgent, decisive environmental action, the roots of today's environmental consciousness stretch back over half a century, explains *Dr Marc Ó Riain*.

Somebody recently asked me why should we be listening to Greta Thunberg and not basing government policy on sound scientific data. I responded that, historically speaking, government policy tends to respond more quickly to public opinion rather than sound scientific evidence. As the nearly zero energy building (NZEB) standard for new and renovated buildings becomes law, the origins of this policy can be mapped back to an emergent environmental consciousness in the 1960s and 1970s.

As Monsanto encouraged the use of pesticides to increase crop yields in the 1960s, Rachel Carson's seminal best-selling book *Silent Spring* (1962) highlighted how pesticides, like DDT, were decimating small bird and animal life. Carson's unsettling description of the poisonous impact of DDT on the human body illustrated the consequences of unregulated industry.

This book helped initiate a public environmental debate with rapid policy action by John F Kennedy's Science Advisory Committee first to restrict and eventually to ban the use of DDTs. Carson was perhaps the first to link the unchecked consequences of industry pollution on habitat and on our own health. As a result, the public started to become interested in the issue of environmental pollution.

As early as 1965, the US President's Science

Advisory Panel had projected that by the year 2000 there would be "about 25% more CO₂ in the atmosphere" causing irreversible and uncontrollable climatic change.

silient planet. 'Earthrise', a photo taken by Apollo 8 astronaut Jim Lovell in 1968, captured the public consciousness in a way that books and science could not, making us "realise just what you have back there on Earth", as Lovell remarked.

NASA engineer James Lovelock's work with chemical concentrations in the Martian atmosphere led him to develop the Gaia hypothesis and the electron capture detector to analyse the chemical state of the Earth's atmosphere. Lovelock viewed a planet of organisms being completely interdependent and a self-regulated single living entity "capable of manipulating the Earth's atmosphere to suit its overall needs".

Gaia theory illustrated that man could have a negative impact on the environment, but that the planet could counterbalance its environment making it uninhabitable for man. This theory builds on Carson's argument that there were actual consequences to uncontrolled technological development, industry and the externalities of pollution. Lovelock's work in Ireland and Britain would eventually lead to the discovery of CFCs and their impact on the ozone.

All of this contributed to a rising public concern for the environment, eventually leading to the first UN Conference on the Human Environment in Stockholm in 1972.



but eventually new oil finds, and fracking technology would, in time, undermine and discredit some of the scenarios put forward in 'LtG'.

Whether 'LtG' scenarios were accurate or not, broad public engagement with the publication created a global political and economic debate which would be echoed by global events in 1973 and subsequent legislation. That year EF Schumacher's book *Small is Beautiful* almost anticipated the immediate future, warning: "the oil crisis will come, not when all the world's oil is exhausted, but when world oil supplies cease to expand".

From the 60s to the early 70s, the above writers and scientists influenced the public dialogue around the environment to such an extent that it would result in some political actions and governmental policy. However, it would not be the fledgling environmental lobby who would change political policy in the early 1970s. It would be a geo-political economic shock, which would spur many countries into policy action to promote energy conservation. The first oil crisis in the winter of 1973 would frame our current international policies on building energy conservation, which will be covered in the next article. ■

“In 1965 the US President's Science Advisory Panel projected that by the year 2000 there would be "about 25% more CO₂ in the atmosphere" causing irreversible and uncontrollable climatic change.

Advisory Panel had projected that by the year 2000 there would be "about 25% more CO₂ in the atmosphere than at present...", causing irreversible and uncontrollable climatic change, and in 1968 Elmer Robinson, a researcher at Stanford, warned that rising CO₂ concentrations in the atmosphere "may be the cause of serious world-wide environmental changes".

In the 1960s, space exploration gave us both the technology and opportunity to reflect on the environmental consequences of unfettered industrial pollution on a once-considered-re-

The conference lent further credibility to the views and claims of the rising environmental movement. Furthermore, it allowed the many grassroots activists who attended the conference direct access to influential political figures. This conference was the first step towards the Kyoto Protocol in 1992, whose target was to cut CO₂ production by 5% from 1990 to 2012.

In 1972 another seminal book by the Club of Rome, *'The Limits to Growth'* (LtG), projected that exponential economic growth would expend finite oil reserves by 1992. The book sparked a lot of debate and criticism,

Dr Marc Ó Riain is a lecturer at the Department of Architecture at Cork Institute of Technology, one of the founding editors of *Iterations* design research journal and practice review, a former president of the Institute of Designers in Ireland, and has completed a PhD in low energy building retrofit, realising Ireland's first commercial NZEB retrofit in 2013.



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Getting to net zero carbon

The UK government has committed to a legally binding target of being “net zero carbon” by 2050. *Peter Rickaby* ponders the steps needed to get there, and what the goal means for our homes, offices and other buildings.

The UK’s commitment to becoming ‘net zero carbon’ (NZC) by 2050 raises some interesting questions. Social housing organisations, whose investment plans span thirty years, are in the front line: they need to start thinking about NZC now, so they are looking for NZC housing retrofit strategies.

Perhaps the most challenging question was posed by a distinguished academic colleague at UCL: “How can you specify net zero carbon retrofit of buildings if you don’t know the extent to which the electricity supply will have been ‘decarbonised’ by 2050?”

That question set me thinking about strategies that avoid guessing what we don’t yet know, not just about decarbonisation of the electricity grid but also about emerging technologies such as local battery storage, waste heat networks and hydrogen replacing natural gas, but instead aiming to get our housing stock ‘NZC ready’ by (say) 2040, with some sort of renewable energy top-up to get to NZC during the following years.

How much solar photovoltaic capacity

The lesson I took from this discussion is that we probably can completely decarbonise the electricity grid, but only if we retrofit all buildings in order to reduce demand — otherwise we won’t have sufficient power.

There is another confounding factor. Removing fossil fuels from buildings and converting them to all-electric heating, hot water and cooking, as recommended by the UK Climate Change Committee, will increase the load on the electricity distribution network beyond its current capacity.

Changing from petrol and diesel-fuelled vehicles to electric vehicles, which we charge from the grid, does the same, and making both changes at the same time will mean that in some places we will dramatically exceed distribution capacity. Local blackouts will probably be inevitable, unless investment in distribution capacity is carefully paced.

So, what about my ‘near NZC plus top-up’ strategy? I think it is still a sound approach, but we must be cautious. Replacing gas-fired boilers with electric heat pumps, and gas hobs with electric induction hobs, is the

approach that has been advocated for many years – fabric first. Improve the long-life building fabric to reduce demand; then improve the shorter life building services, in stages (hybrids, heat pumps, batteries) to satisfy the residual demand efficiently; then top up to NZC with solar PV, local wind-power or hydrogen, when we know how much carbon is left to remove.

The NZC target raises questions to which we don’t yet have robust answers. Perhaps the last questions worth raising are the most controversial: if by 2050 all our homes (and other buildings) are all-electric, and the electricity supply is carbon-free, will they really need to have been retrofitted to a standard quite as high as passive house? Obviously we will still want to heavily reduce demand and deliver comfortable, warm and healthy homes — but will they really need to be super-airtight? Will they really need heat recovery ventilation? I guess that the cost of electricity will be an important factor, but if heating our homes does not involve emissions, will allowing a little more heat loss (and some natural ventilation) really be a problem? ■

“We probably can completely decarbonise the electricity grid, but only if we retrofit all buildings.

With thanks and apologies to Professor Tadj Oreszczyn at UCL Energy Institute, whose ideas I have probably misunderstood, or at best misrepresented.

would we need for that, and would there be sufficient roof space to accommodate it? Would we need community wind power as well as solar PV?

My academic colleague wasn’t impressed by this approach. He showed me analyses suggesting that, given the way generation costs are changing, it should be possible to completely decarbonise the UK electricity grid by 2050 using mostly wind power. The problem is that this needs nearly thirty times as much wind power capacity as we have at present.

That’s challenging, but if we deep retrofit the housing stock (building fabric and building services) then that figure can be reduced to perhaps fifteen times as much capacity as we have at present. And if we also improve our non-domestic buildings, we might get away with ten times as much capacity.

right thing to do, but not all at once. Let’s get electric vehicles (EVs) established first, so that we don’t immediately overload the grid, and to give the car industry time to develop better batteries that we can use in our homes.

Perhaps the next generation of heating appliances should be hybrid heat pumps – a mini gas-fired boiler and a small air-to-water heat pump in the same box, with the heat pump leading and the gas boiler only firing when there is insufficient heat in very cold winter air to maintain the efficiency of the heat pump, or to top-up the hot water. Then, at the next change of appliance, we can replace the hybrids with true heat pumps, just as we are replacing hybrid cars with EVs, fifteen years on.

Having made this rather elaborate argument, I am struck that the ‘near NZC plus top-up’ strategy amounts to a retrofit

Dr Peter Rickaby is an independent energy and sustainability consultant. He chairs the BSI Retrofit Standards Task Group and helps to run the UK Centre for Moisture in Buildings at University College London.



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OFFICE ROMANCE

PASSIVE HOUSE SUPPLIER WALKS THE WALK WITH NEW OFFICE & FACTORY

When Welsh sustainable building specialists PYC decided to start making their own timber frames, they got down to work designing and building their own factory. Once that was finished, it was time to test their system on their first order: to build their own passive house certified offices right next door – and to be bold enough to decide not to install central heating.

Words by John Cradden

Welsh firm PYC are a bit of a sustainable building juggernaut, with separate divisions specialising in insulation, airtightness, and the design of low energy, timber frame buildings.

“We started thinking about building new premises several years ago because we’d outgrown the previous office space,” says the company’s managing director, Jasper Meade. “We also had no manufacturing capability to build our own timber frames and we were struggling to outsource the new specifications we’d introduced.”

In 2014, the company found a greenfield site on an industrial estate in Welshpool, just a few miles from their old offices. As well as the fast transport links, staff could continue to live locally. Meade made preliminary sketches for the entire site on a

train journey to London one day. The most important elements, he felt, were a factory containing a small office and observation room, a larger separate office building, car park, outside storage, meeting room, kitchen and toilets.

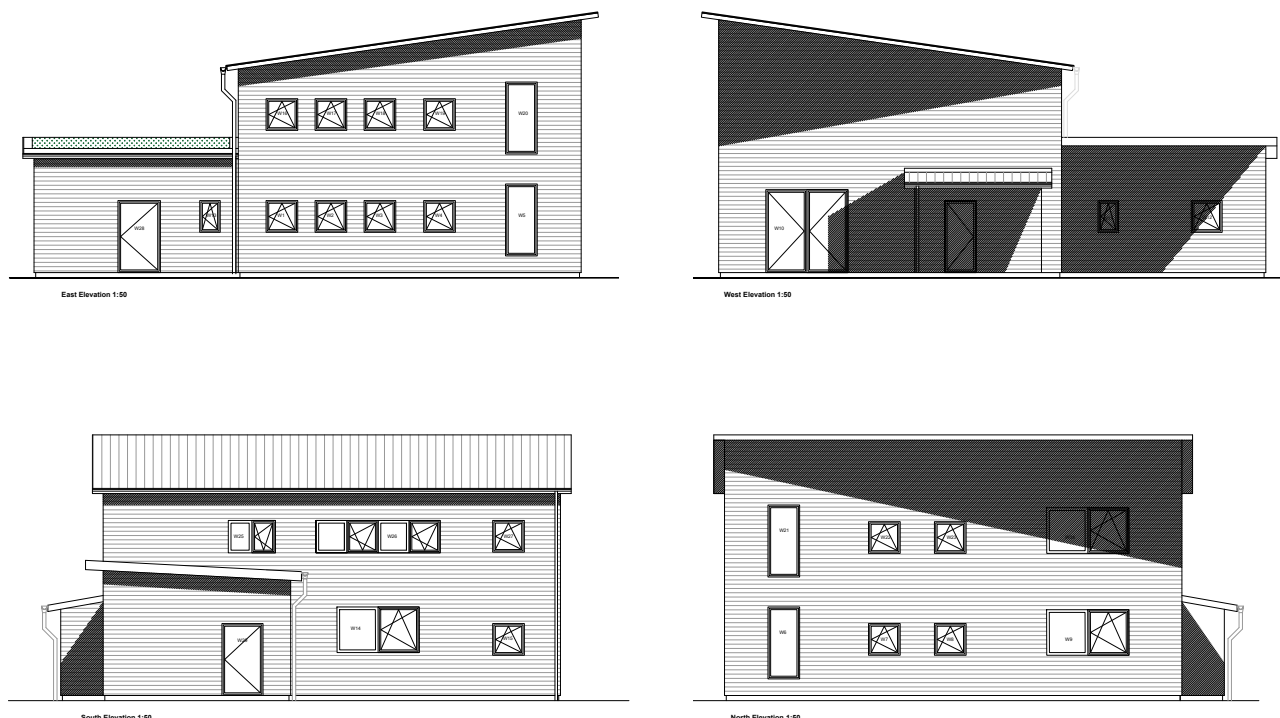
As a company with long-term growth plans, PYC also needed space to breathe, he felt. “The hardest challenge was future-proofing the building. We had to make sure there was room for expansion in both the factory and the offices.”

But it turned out to be much trickier than Meade anticipated to get the project off the ground. PYC applied for planning permission for the whole site in 2014, but it wasn’t achieved until 2016, when the company finally bought the land and started building the factory. “It was surprisingly hard to get all the finance and planning approvals,

including environmental and noise assessments and all the financial forecasts so we could be sure the plans would work,” Meade says.

Surprisingly, the greatest stumbling block proved to be the Welsh government’s uncertainty about whether passive house was an acceptable standard to build to (specifically, PYC were asked whether passive house is as good a standard as BREEAM – and given that the former focuses on operational energy use and indoor air quality, while the latter is a more general green building certification, the question isn’t really comparing like with like).

But Meade has always been a passionate believer in changing minds through educating people about sustainable buildings. The PYC team, he says, did a



£47

per month
(estimated space heating cost – but
the real figure is likely far lower)

Building: 220 m² office building
Location: Welshpool, Powys
Build method: Timber frame
Budget: £350,000
Standard: Passive house certified

“

We felt building the offices to passive house standards would exemplify the work we do.

good job in “demonstrating to the government that the energy performance of this standard superseded all others”, with some help from leading passive house design firm Architype, and the Welsh government ultimately gave the green light.

Work began to put up the factory in 2016. PYC hired a nearby yard, where they built the frames for the factory. Nine months later, the factory was up and ready to start producing its own timber frames. So the PYC team turned their attention to their new office building.

“After we’d made the panels in the factory, it took just a couple of weeks to put them up, but then the internal works took months, including electrics, plumbing and external finishes. We mostly used the PYC team for construction, which slowed us down because they could only be on site when not working on other projects.”

Meade says that PYC’s decision to build the office to the passive house standard was a “natural progression” given the company’s tradition of sustainable building. In 2016, PYC ran a passive house designer training course which two of the company’s employees attended. Afterwards, Meade gave them the task of designing the new office building.

“We felt building the offices to passive house standards would exemplify the work we do,” he says. “But there were other major benefits, too, such as being cheap to run, comfortable and healthy for workers. After all, we all tend to spend more working hours in the office these days.”

For many years, PYC used twin frame and Larson truss systems, but they chose to

experiment with a new approach, building both the factory and the office with an I-beam system.

“I-beams are a highly engineered component with multiple size options available, giving us the option of the variables we need to cover for the design space, as well as U-value options,” Meade says. “This offers us a single stud frame system which is economical in timber use yet maintains the high performances that we required.”

After several design and engineering revisions, I-beam has now become PYC’s standard construction method. “Looking back today after three years of using the I-beam system in the factory, our experience has been that it creates a comfortable working environment and real benefits in energy performance,” says Meade.

The company’s love of timber also influenced the office designs, and there are many wooden features in the internal spaces, the vast majority of it in Welsh timber. For example, PYC installed wooden supporting posts and beams for the floor, and Welsh spruce glulam walls. They chose poplar internal lining boarding and birch end-grain flooring. Meanwhile, the external walls were clad with more than 7 km of Douglas fir weather boarding.

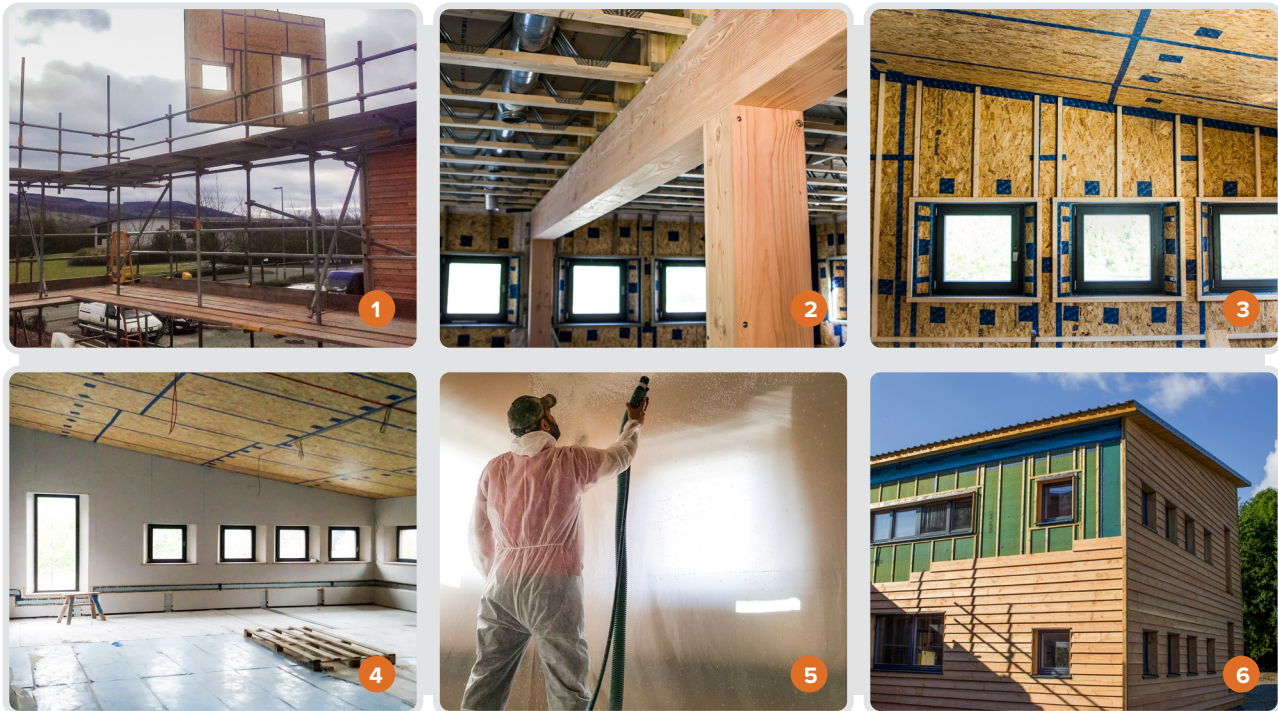
None of the PYC staff had experienced living or working in a passive house environment before, and both performance and comfort exceeded everyone’s expectations. “We consider our office very much a living space, making the comfort, health and wellbeing of all who work here important,” says Meade. “The materials

FACTORY CONSTRUCTION IN PROGRESS



1 The factory was built using PYC's closed panel system wrapped around a steel portal frame; **2** erection of the closed panel system for the walls; **3** the roof panels being fitted into place; **4** PYC workers clad the factory with locally sourced Welsh Douglas fir; **5** interior of the factory; **6** close up of one of the panels, with airtightness taping and Solitex Fronta WA breather membrane.

OFFICE CONSTRUCTION IN PROGRESS



1 A crane lifts a wall panel into place; **2** the build used Douglas fir "Ty Unnos" box beams; **3** OSB taped at all joints with pro clima Tescon Vana; **4** Gyproc plasterboard fitted to interior walls; **5** applying the Soundcel (sprayed recycled newspaper) acoustic insulation to the ceiling of the first floor office; **6** external walls feature 25 mm Isoplaat woodfibre board and 20 mm Welsh Douglas fir horizontal cladding.

we used are the key to making this work. Specifically, the Warmcel [cellulose insulation] in the walls and roof offers stable temperatures, providing thermal comfort in summer and winter."

PYC's employees moved into the office shortly before the exceptionally hot 2018 summer, which saw regular ambient temperatures of 28C, and higher peaks. It took a while to get to grips with the MVHR system, but the team spent many summer days working with windows open. "This felt right for us and it dispelled the common misconception about never opening windows in a passive house," Meade said. "With over 31C outside we never got above 26C inside."

The winter of 2018 was comfortable in the office too, Meade says. The team logged daily temperatures for several locations on the premises, and readings showed consistent average internal temperatures of 21.5C. On the rare occasions when the office temperature dropped to around 15C following a weekend of sub-zero weather, a small electric heater soon fixed the problem on Monday morning. The heater was barely required again for the rest of the week.

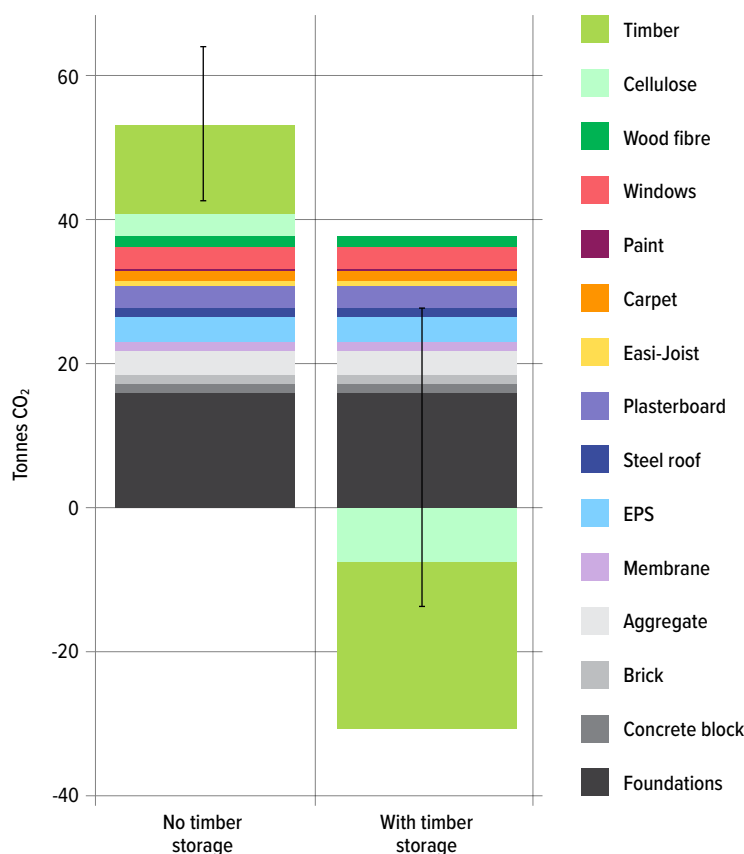
In keeping with the true spirit of the passive house standard, the team had decided not to install any conventional central heating system. "This was always the plan," Meade says. "Typically, our customers fit a 'just in case' system such as underfloor heating or even a small log stove. We knew from experience that this would be unnecessary, now we can prove it!"

The final airtightness test result on the office building was 0.5 air changes per hour. PYC carried out airtightness tests before and after the installation of the Warmcel, and noted a 24% improvement in the result. "This wasn't surprising news to us as we already knew it was full-fill, knit fibre and high-density. Warmcel shouldn't be relied on to provide airtightness, but it certainly helps," Meade says.

PYC also spent a lot of time testing the application of Soundcel sprayed-cellulose acoustic insulation on the ceiling of



EMBODIED CO₂ - PYC OFFICES



The above graph shows the embodied carbon for the PYC offices, broken down by component materials. The graph on the left does not include the carbon stored in the timber; the graph on the right does. The one on the right shows that the carbon storage for the building materials is similar in scale to the emissions of manufacture, however an official calculation (by RICS guidelines) would also need to include the end of life stage, which may involve re-release of CO₂ via burning and/or decay, or continued storage if the timber can be reused or recycled. There is still debate about how and when carbon storage in timber products should be counted, for various reasons. For example, some natural carbon stores (such as peat soils) may have been disturbed during afforestation, and of course there is uncertainty over how soon the carbon will be returned to the atmosphere at the end of the material/building's life. Graph calculated by Tim Martel using the PHribbon plugin for PHPP.

“

After we'd made the panels in the factory, it took just a couple of weeks to put them up.

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the first-floor office. Getting the mix and texture right called on all their experience, but the results were worth it in the end. "Such an open space has a risk of echo, but the textured finish of the Soundcel on such a large area reduces any sound resonance," says Meade. "A simple mix of Soundcel and PVA glue sprayed to a depth of 15 to 20 mm also gave the office a different feel to a conventional plasterboard finish."

Final Passive house certification was not achieved until April 2019, but the entire process provided invaluable lessons. "We learned a lot during the construction of the offices as it allowed us to develop, trial and review all our processes and systems. For example, we learned important lessons about design detailing, on-site construction and erecting I-beams," Meade says.

Working out of their Welshpool office allows PYC to show off the advantages of passive house construction and low-energy timber frames. Meade says the company likes to invite prospective clients into the space, including self-builders, architects, local authorities, as well as local businesses and schools.

"We're also keen to share what we've learned about passive house and energy efficient building. We're already working with the Welsh government and we're helping to train the next generation of architects and designers, as well as making links with local colleges."

SELECTED PROJECT DETAILS

Client: PYC Group

Architect: PYC Design

Main contractor/timber frame/M&E engineer: PYC Construction

Structural engineer:

Bob Johnson Structural Engineers

Mechanical contractor:

Steve Smith Plumbing & Heating

Electrical contractor:

Maden and Powys Electrical

Airtightness testing: PYC Systems

Wall insulation:

Warmcel, via PYC Insulation

Additional wall insulation:

Isoplaat woodfibre board

Thermal breaks:

Compacfoam, via Green Building Store

Floor insulation: Boys & Boden

Airtightness products:

pro clima, via PYC Systems

Windows & doors:

Green Building Store

MVHR: Systemair

Furniture: Kenton Jones Ltd

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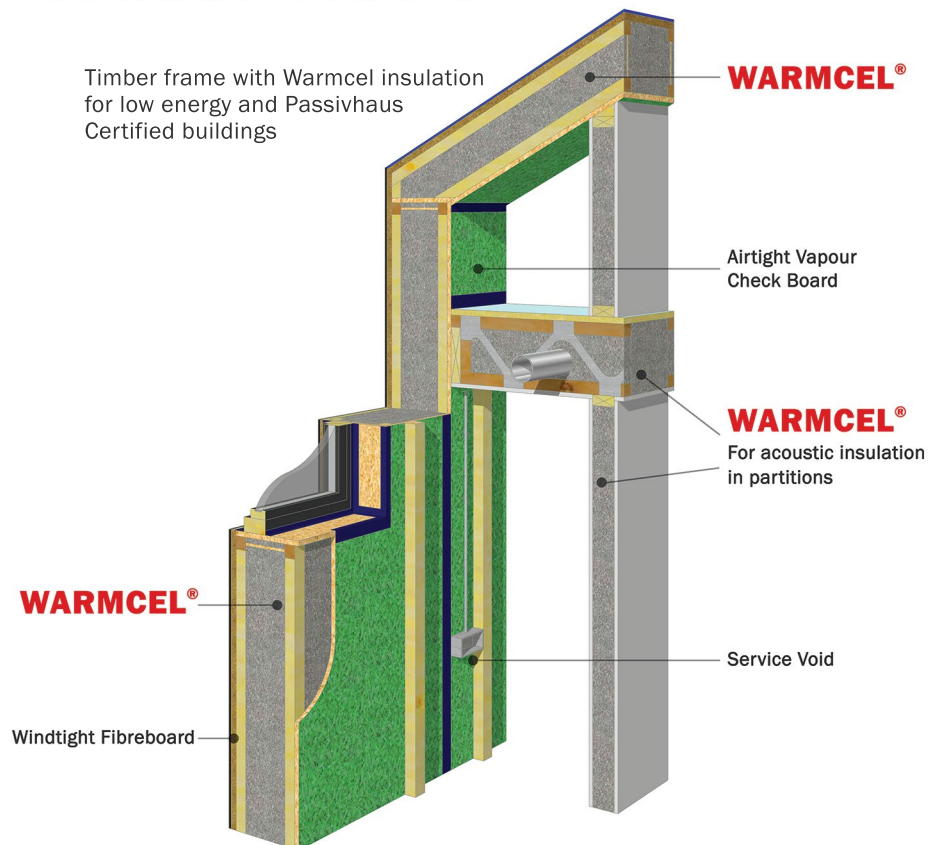
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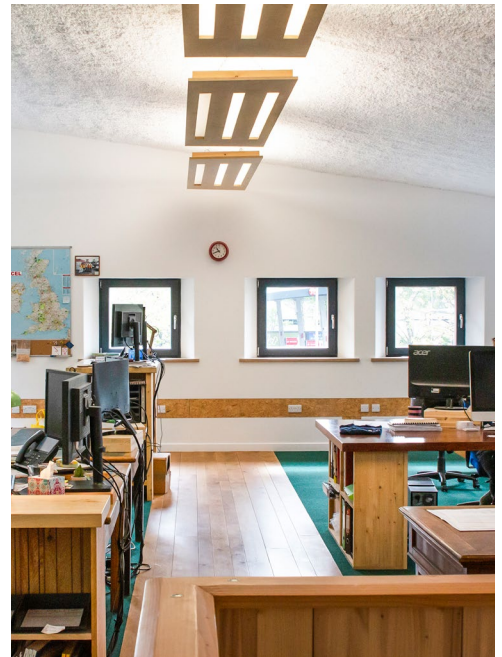
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PYC Certified Passivhaus Office



IN DETAIL

Building type: 220 m² timber frame office

Location: Welshpool, Powys

Completion date: May 2018

Budget: £350,000

Passive house certification:
Passive house certified (classic standard)

Space heating demand (PHPP):
14 kWh/m²/yr

Heat load (PHPP): 10 W/m²

Primary energy demand (PHPP):
134 kWh/m²/yr

Heat loss form factor (PHPP): 3.2

Number of occupants: Around 10 employees

Overheating (PHPP): 3%

Airtightness (at 50 Pascals):
0.5 ACH (n50) or 0.62m³/m²/hr (q50)

Measured energy consumption & bills: The office & factory are on the same electricity meter, so it is difficult to separate heating energy consumption from manufacturing etc. All space heating and hot water is met via mains electric. This is with the intention of introducing a large array of PV panels which will provide all the power required to make the offices off-grid in future.

As per PHPP calculations for the office building only, total space heating demand is 3,024 kWh/a. Hot water demand is 2,584 kWh/a and is met via an instantaneous electric water heater and shower. Non-residential electric demand of 3,233

kWh/a. Total energy demand: 8,841 kWh/a. Currently with an electric tariff of 18.8p per kWh this would provide an estimated annual electric bill of £1,662 of which £568 would be for space heating (not including standing charges). However, as in practice all space heating is met via a small 1kW portable electric heater, the actual amount is likely to be far less.

Thermal bridging: PYC Design undertook detailed design to ensure cold bridge-free design.

Ground floor: 20 mm engineered oak flooring (entrance lobby) / 10 mm Welsh birch end grain cobbles (GF dining room), VOC-free carpet (Offices). Timber finished with OSMO oils. 200 mm reinforced concrete slab on DPM, on 300 mm of EPS insulation under slab and 200 mm EPS perimeter insulation, on 50 mm sand blind, on Type 1 compacted hardcore. U-value: 0.116 W/m²K

Walls: 20 mm Welsh Douglas fir horizontal cladding externally, fixed to 25x50 mm treated horizontal battens on 25x50 mm treated vertical counter battens providing ventilated cavity, followed inside by pro clima Fronta WA breather membrane taped at joints with pro clima Tescon Vana, 25 mm Isoplaat woodfibre board, 400 mm Masonite I-beam studs @ 600 mm c/c, fully filled with Warmcel cellulose fibre insulation, 15 mm OSB taped at all joints with pro clima Tescon Vana, 50x50 mm service batten, 12.5 mm Gyproc plasterboard, skim and low VOC white emulsion or Welsh poplar timber cladding. U-value: 0.10 W/m²K

Mono pitched roof: Powder coated box profile steel roofing sheets externally, fixed to 75x50 mm treated battens, followed inside by 25x50 mm treated CLS counter

battens. This makeup created, drainage, ventilated cavity and overhang, pro clima Solitex Plus laid over 25 mm Isoplaat woodfibre board, 400 mm I-beam rafters @ 600 mm c/c, fully filled with Warmcel cellulose insulation, 15 mm OSB taped at joints with pro clima Tescon Vana, Soundcel (sprayed recycled newspaper) acoustic insulation. U-value: 0.092 W/m²K

Flat roof: Baileys Atlantic single ply membrane laid over 18 mm WBP plywood decking, fixed to 50x50 mm treated battens, followed inside by pro clima Solitex Plus laid over 25 mm Isoplaat woodfibre board, 400 mm I-beam rafters @ 600 mm c/c, fully filled with Warmcel cellulose insulation, 15 mm OSB taped at joints with pro clima Tescon Vana, Soundcel (sprayed recycled newspaper) acoustic insulation. U-value: 0.092 W/m²K

Windows & external doors: Green Building Store Ultra triple glazed timber framed windows. Passive House Institute certified. Sealed with pro clima tapes. Overall U-value: 0.79 W/m²K

Heating system: No primary heating. Small 1kw moveable heater. Direct electric heating for domestic hot water.

Ventilation: PHI certified Systemair VTC 700 MVHR system. Efficiency 77% (PHI).

Shading: Large roof overhang.

Green materials: Use of locally sourced Welsh timbers, including external Douglas fir cladding, internal Poplar cladding to walls, Birch endgrain flooring, bespoke made Welsh spruce CLT internal walls and Douglas fir "Ty Unnos" box beams. Recycled newspaper cellulose fibre insulation (Warmcel). Low VOC finishes, paints and oils.



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Building: Social housing scheme of 45 houses & 60 flats. Timber frame.

Completed: 2019

Location: Goldsmith Street, Norwich

Budget: £14.5m

Standard: Passive house certified

STIRLING WORK

The passive social housing scheme that won British architecture's top award



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Early in October, Norwich City Council's Goldsmith Street development became both the first passive house and the first social housing project to win the Stirling Prize, British architecture's most coveted award, with the judges calling it "high-quality architecture in its purest, most environmentally and socially conscious form". Leading building energy expert *Dr Peter Rickaby* visited the scheme for Passive House Plus to see this ground-breaking project for himself.

Local authority housing is at last being revived in the UK. For nearly four decades new developments in the social housing sector have been dominated by housing associations or 'registered providers' – ever larger, ever more corporate organisations, ever more exclusively focussed on unimaginative regulatory compliance, ever more wedded to procurement by design-and-build, despite its endless legacy of defects and poor performance. Against this backdrop, new local authority housing is blowing a breath of fresh air through the sector.

Nowhere is this more evident than in Norwich, where the city council has an extensive programme of new homes, is committed to quality and sustainability via the passive house standard (with over a thousand passive homes in its development programme) and is willing to innovate, experiment and challenge convention.

The combination of Norwich City Council's sustainable community development policy and architects Mikhail Riches' professional and technical skills has resulted in an outstanding new housing scheme that is not only passive house certified but has won British architecture's top accolade – the Stirling Prize. It is fitting that, as we move towards net zero-carbon new housing, the Stirling Prize has been awarded to a social housing scheme for the first time.

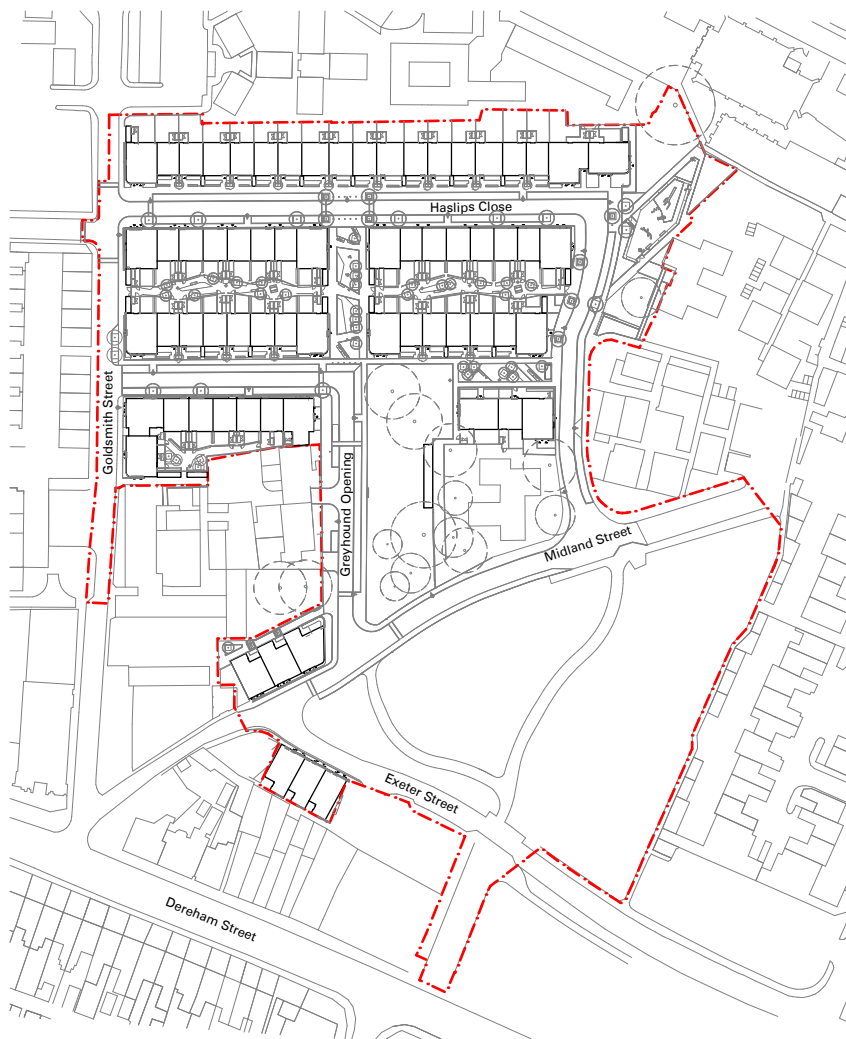
The housing development at Goldsmith Street originated from a RIBA competition, for which Mikhail Riches submitted a passive solar design laid out in parallel east-west terraces arranged to admit low-angle winter sun to the homes, in order to benefit from solar heat gains, and to exclude the high-angle summer sun. Norwich City Council's subsequent request to apply the passive house standard informed and focused the energy strategy for the resulting design.

The passive solar approach was retained. Terraces of two-storey houses have been spaced to preserve solar access to the south-facing ground-floor spaces in every house, but a cleverly placed and oriented expanded metal brise-soleil over every south-facing window shades out the high-angle summer sun to reduce overheating.

'An urban feel, and sense of community'

The blocks are spaced 14 m apart between fronts, and 14 m between backs (rather than the more conventional 22 m spacing) to increase the density (which is 82 dwellings per hectare) and promote an urban feel, and a sense of community. The terraces are terminated at each end by three-storey blocks of three flats each.

The details of the layout demonstrate the architects' skill in defining private, semi-private, shared and public external spaces between the buildings. Every south-facing house has some protected



front garden space on the street side. Every north-facing house and flat has a small sheltered external porch, and every flat has its own entrance door at street level – there are no internal 'common parts'. Every house also has a private rear garden and every flat has a substantial balcony with a pierced brick balustrade for privacy.

Between the terraces are shared, sinuous, linear spaces ('ginnels'), securely gated at each end, where neighbours meet, families gather, and children play in safety. There is also a play area for small children, a wildflower meadow and a central landscaped space. Parking is provided on the street, and the streets connect (there are no cul-de-sacs or parking courts) but the design deters speed and fosters community.

Throughout, the hard and soft landscaping is impressive – surfaces for driving, parking, walking and playing are defined by high-quality materials differentiated by texture and colour. Front boundaries are simple metal and wire fences submerged by growing vines and shrubs. Rear gates and fences are boarded timber – just high enough to provide privacy but not so high as to intimidate or block daylight. Cheap

“

New local authority housing is blowing a breath of fresh air through the sector.



but neatly detailed anodised expanded metal panels are used to screen bin stores and meter boxes.

Internally, two-bedroom, four-person houses are 90 m²; four-bedroom, six-person houses are 121 m²; and one-bedroom, two-person flats vary from 52 m² to 64 m² according to floor level. House layouts vary according to whether they are entered from the north or the south. In the houses, all rooms are daylight except for ground floor WCs; in the flats, the bathrooms are the only internal spaces without windows.

The houses have living areas and generous kitchens including dining spaces. The flats have smaller kitchens, with combined living and dining spaces. All homes are bright and spacious, with high quality finishes and tall windows. Windows that are close to the street, or south facing, have internal timber shutters, and most residents have fitted blinds for privacy and to control glare.

Passive-grade timber frame

The buildings are timber-framed, using panels manufactured off-site by passive house veterans Cygnum. Walls incorporate Warmcel recycled cellulose insulation within the panels and rigid insulation boards on the outsides. The front elevations of the houses, and the blocks of flats, are clad with light-coloured clay bricks; the rear elevations of the houses are simply rendered (a value engineering casualty), and the render is coloured to match the brickwork.

To achieve passive house insulation standards, the brick-clad walls are approximately 600 mm thick, including the cladding, and the rendered walls are approximately 500 mm thick, so windows have deep, insulated reveals, sills and soffits. Window openings, which are larger than the windows themselves, expose the rendered insulation layer externally as window surrounds, and have pre-cast concrete sills. The windows themselves are triple glazed Idealcombi Futura+ composite units with powder-coated external sills.

The roofs are mostly shallow pitched (~30 degrees), facing north or south, with some steep pitched (~80 degrees) roofs on the larger houses and blocks of flats. All roofs are covered with shiny black glazed pantiles, with minimal eaves overhangs and clipped verges. The average tested airtightness of the building envelope for the development is 0.57 air changes per hour at 50 Pascals (see 'In detail' for more).

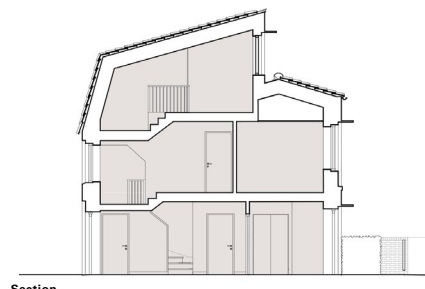
All homes have central heating systems consisting of gas-fired condensing boilers supplying heat to radiators, and hot water. Ventilation is provided by Paul passive house certified MVHR systems. Internal air quality is excellent, and residents report minimal use of the heating. For architectural reasons all flues and ventilation terminals are located on the rear elevations. There is scope for solar photovoltaic (PV)



Section
House Type A - 2b 4p
South Entered Terrace



Section
House Type D - 2b 4p
North Entered Terrace



Section
House Type C - 4b 6p
South Entered Terrace

panels to be added to the south-facing pitches, in the future, to bring the energy performance of the homes close to 'net zero carbon'.

'Elegant, beautifully detailed'

Architecturally, the quality of Goldsmith Street derives from three features. First, the simple built form of parallel straight terraces of two-storey houses 'book ended' by the blocks of flats. The terraces are a local built form that integrates the development into the area. The flats not only increase the scale, presence and urban feel of the buildings but also define the individual terraces and subtly mark the entrances to the development, without in any way separating residents from their neighbours living in the houses.

The second feature is the traditional, almost Georgian, proportions of the elevations. Often when the form of a building is simple and repetitive it is the windows that provide the opportunities for architectural expression, for rhythm and proportion. Mikhail Riches have exploited this opportunity with architectural skill that is rarely seen in modern housing.

The visual enlargement of the window openings by exposing the insulated wall behind the brick cladding as window surrounds (especially below the windows) is inspired. The subtle 'ghost window' treatment of the panels of brickwork and render where there are no windows, in order to retain the rhythm, is clever and displays an architectural sense of humour.

The third feature is simply attention to detail. I have often remarked that the energy 'performance gap' in modern buildings is an attention to detail deficit, and that the passive house standard not only requires attention to detail but also identifies which details are important. At Goldsmith Street attention to detail has been applied not just to the performance of the buildings but to their construction, appearance and style. The thoroughness and consistency of the detailing helps to turn buildings of simple form into architecture.

It is to Norwich City Council's credit that the Goldsmith Street development was procured traditionally, not by design-and-build. The architects' commission extended through the construction phase, enabling

them to inspect progress and quality on site, uphold the importance of architectural features and attention to detail, and help the contractor RG Carter to cope with the demands of the passive house standard.

It is often said that great architecture requires not only a skilled architect but also a committed client who shares the architect's vision of what their project could be like and holds them to that vision. It is a credit to both Norwich City Council and Mikhail Riches that their strong, positive relationship has delivered this elegant, beautifully detailed, high-performance housing development that sets a standard for local authority housing in the future.

Goldsmith Street is a demonstration that energy performance can be combined with superb place-making, and that architectural quality and the passive house standard can go hand-in-hand, through rigorous, consistent attention to detail. Residents of Goldsmith Street declare themselves delighted with their new homes. During my visit one couple, residents of a flat, stated that their friends who have struggled to buy their own homes elsewhere are envious of the quality and comfort of the accommodation they have. It is difficult to think of a better recommendation than that.

A MODEST MASTERPIECE

The judging panel for the 2019 Stirling Prize, which was chaired by leading architect Julia Barfield, said of the project: "Goldsmith Street is a modest masterpiece. It is high-quality architecture in its purest, most environmentally and socially conscious form. Behind restrained creamy façades are impeccably-detailed, highly sustainable homes – an incredible achievement for a development of this scale. This is proper social housing, over ten years in the making, delivered by an ambitious and thoughtful council. These desirable, spacious, low-energy properties should be the norm for all council housing."

“

All homes are bright and spacious, with high quality finishes and tall windows.



PASSIVE HOUSE FOR YOUR WATER SYSTEM

By Toby Cambray, Greengauge

The space heating and hot water at Goldsmith Street are delivered by combi boilers, with a small number of radiators, and carefully optimised hot water distribution. “We designed the hot water layouts using the principles in the AECB water standards, which are completely brilliant and really under-rated,” says Sally Godber of passive house consultants WARM. “They are like passive house for your water system. The key is to calculate everything and keep dead-legs to a minimum in both length and diameter, which reduces distribution losses. These losses impact both energy consumption and overheating, so it’s a massive win.”

“For future projects there are some things we might change; primarily we need to consider less carbon intense options for hot water heating.”

Ventilation is via a Paul MVHR unit in each dwelling. The design was carefully developed so most homes have a very simple, repetitive layout which means the quality of installation (particularly key for insulating ductwork) is

dependable. This was coordinated in 3D with specialist technical support from the Green Building Store, who supplied the Paul systems. “The design manages to conceal all services in a pretty tight design, so the very accurate model proved very useful on site,” says Adam Lane of Greengauge.

One of the least obvious but most challenging aspects of a project like this is the coordination of the utilities. “The architects challenged us to avoid having meter boxes scattered everywhere,” says Hannah Jones of Greengauge. “This is much easier said than done, because the normal approach has developed from a combination of safety features and ease of installation and meter reading. It was hard work to do something different, but the result is no white boxes cluttering the façade.”

WARM and Greengauge worked together on the building services design; WARM led the mechanical design whilst Greengauge undertook the electrical design, BIM modelling and design of the utilities.



above Drone shots of the site on the west side of Norwich city, showing progress from the beginning of works to the completion of the build.

MAKING 105 BUILDING ENVELOPES AIRTIGHT

As with any passive house project, airtightness was one of the major challenges at Goldsmith Street, where there were 105 different building envelopes to be air-sealed and tested.

Leading Irish manufacturer Cygnum Building Offsite supplied the timber frame for the job. And while the firm has extensive experience working on large passive house buildings in the UK, the company's managing director John Desmond told Passive House Plus that a project like Goldsmith Street, where building fabric detailing is multiplied over 105 units, presented a different type of challenge.

"While it doesn't bring the major structural challenges, it does bring its own operational challenges," he says. "This project was built to a pretty ambitious and challenging build programme. We started works on site on 17 June and completed all the blocks, bar one, by that Christmas. At any one time we had three to four crews on site with different tasks."

"The first crew erected the structural framework of the building — the internal leaf of the external walls, the mid

floor, and the roof structure. That was followed on by a team erecting the external timber frame leaf, then a third team finishing off the airtightness detailing. Finally, we had a crew fitting the Warmcel insulation. We sent about four articulated lorry loads of timber frame to site every week."

Cygnum were responsible for ensuring the airtightness of the timber frame up until the installation of the windows and building services. Three air tests were carried out on each dwelling: the first when Cygnum completed their installation, the second after building services and windows were fitted, and the third on practical completion. All the houses were tested individually: the best final result was 0.39 air changes per hour, the worst was 0.63 (the backstop for passive houses being 0.649). The development was passive house certified terrace-by-terrace, with an average overall score for the whole development of 0.57.

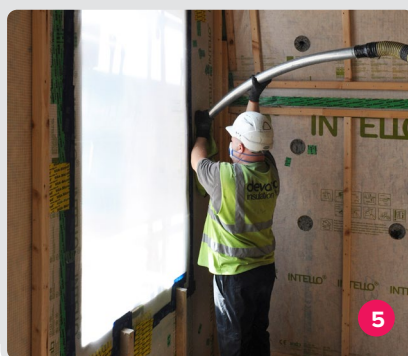
Desmond says that a collaborative spirit was key to the success of the project. "Everyone needed to be moving in the one direction, and that was very much an overriding characteristic of this job."

SELECTED PROJECT DETAILS

Developer: Norwich City Council
Architect: Mikhail Riches
Contractor: RG Carter
Timber frame: Cygnum Building Offsite
Landscape architects: BBUK Landscape Architecture
Clerk of Works: Enhabit
Passive house consultant: WARM
Building services design: Greengauge & WARM
Passive house certification: Etude
Structural engineer: Rossi Long
Quantity surveyor: Hamson Barron Smith
Windows & doors: Idealcombi
External insulation: Permarock
Cellulose insulation: Warmcel, via PYC Group
PIR: Celotex
Floor insulation system: Forterra
Thermal blocks: Foamglas/Thermalite
Perimeter subfloor insulation: Jablite
Airtightness products: Ecological Building Systems, via Green Building Store
OSB: Medite SmartPly
MVHR: Paul, via Green Building Store
Gas boilers: Vaillant
Radiators: Stelrad



CONSTRUCTION IN PROGRESS



1 Grey EPS around the foot of the buildings to prevent thermal bridging here; **2** bringing the Cygnum timber frame panels to site; **3** the panels, which feature a two-stud system, stacked on site prior to installation and insulation; **4** the timber frame structure going up for one of the terraces, with pro clima Intello airtightness membranes installed; **5** pump-filling the walls with Warmcel recycled cellulose insulation; **6** pro clima Solitex Plus breather membrane installed on the roof with battens externally, prior to installation of the clay pan tiles.



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Figures: Help Solve the Housing Crisis - Report by the All-Party Parliamentary Group for the Timber Industries.

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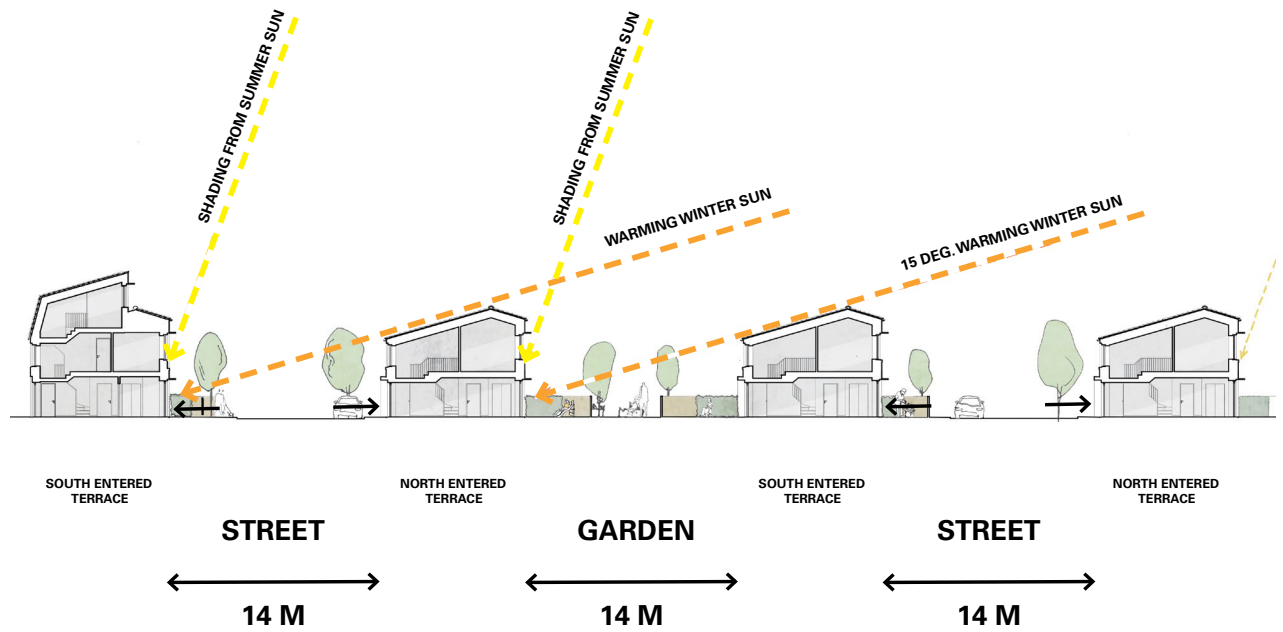


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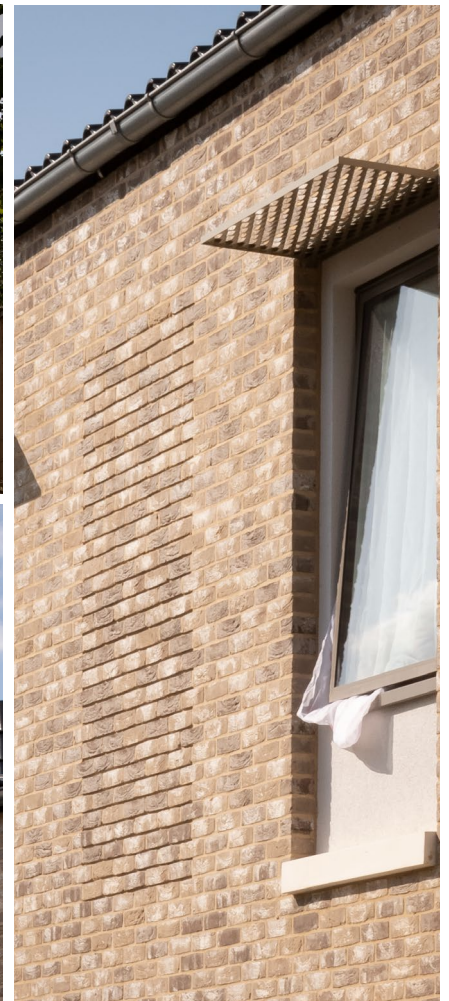
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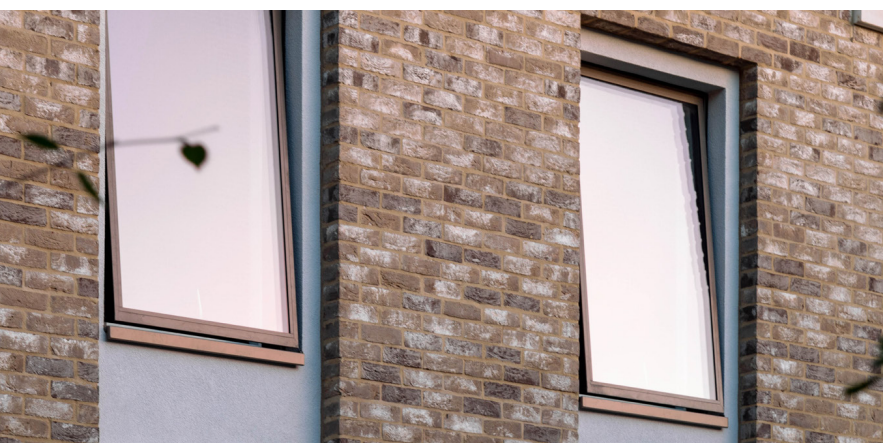
above Graphic showing how the shading design of the terraces is configured to allow in low angle winter sun, but to block out the high angle summer sun that is associated with overheating; 14 metre spacing between rows (as opposed to the conventional 22 metres) helps to create an urban feel.



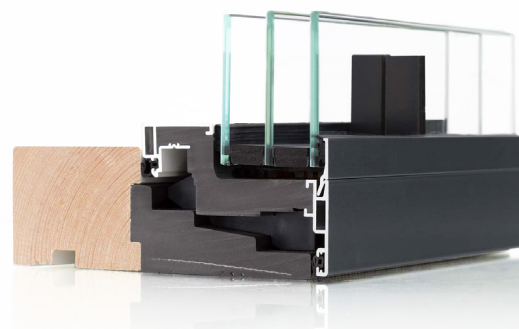
Read more about this project in detail



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IN DETAIL

Building type:

Social housing scheme of 45 houses & 60 flats, all timber frame. Floor area from 51 m² to 121 m².

Location: Goldsmith Street, Norwich

Site size: 1.2809 ha

Net density: 82 dwellings/ha

Completion date:

2019 (all residents had moved in by June)

Budget: £14.5m / £1,875 per m² (the latter figure excludes professional fees)

Passive house certification: Certified (passive house classic)

(PHPP information below is for one terrace of 11 dwellings. The development was certified terrace by terrace)

Space heating demand (PHPP):

13 kWh/m²/yr

Heat load (PHPP): 10 W/m²

Primary energy demand (PHPP):

115 kWh/m²/yr

Heat loss form factor (PHPP):

Terrace form factor ranges from 2.66 to 2.85

Overheating (PHPP):

4.8% of year above 25°C

Airtightness (at 50 Pascals): 0.57 air changes per hour. This is the average for all blocks. The airtightness test was carried out home-by-home and then an area weighted average used. Each home passed the air test individually as well. The worst score was 0.63 ACH, the best 0.39 ACH.

Energy performance certificate (EPC):

Generally, in the range of B82 to B87.

Measured energy consumption:

Not yet available.

Energy bills (measured or estimated): We estimate annual space heating only bills of approximately €31, €55 and €74 respectively for the three sizes of dwellings based on PHPP space heating demand, gas price of 4.3p per kWh (confusedaboutenergy.co.uk, includes VAT) & boiler efficiency of 90%.

Ground floor: 75 mm screed followed beneath by 225 mm PIR and then 150 mm Jetfloor EPS. U-value: 0.081 W/m²K

Walls: Cygnum timber frame featuring Protect TF200 membrane externally, followed inside by 9 mm OSB and then twin-stud system featuring 38x67 mm external 'fin' wall & 38x89 mm internal structural stud, comprising

total insulation depth of 380 mm, which was filled with Warmcel. Followed inside by 9 mm OSB, pro clima Intello membrane services zone & plasterboard internally. Walls finished externally with brickwork & ventilated cavity (U-value: 0.110 W/ m²K) or 140 mm Permarock external insulation (U-value: 0.083 W/m²K)

Roof: Gloss black clay pan tiles externally, followed inside by 44 x 50 mm ventilation battens, pro clima Solitex breather membrane, 12 mm Medite sheathing, 400 mm I-joist fully filled with Warmcel, 9 mm OSB sheathing, pro clima Intello Plus membrane, services zone of 44 x 46 mm battens, plasterboard internally. U-value: 0.097 W/m²K

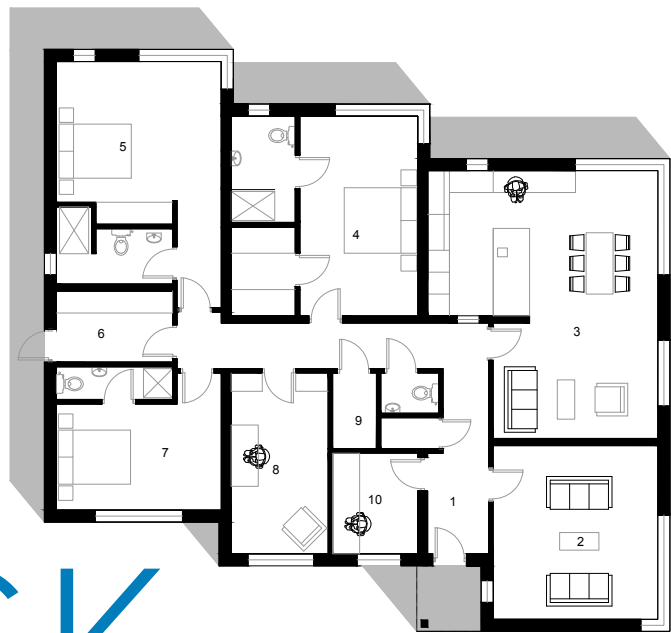
Windows & external doors: Idealcombi Future+ triple glazed timber frame alu-clad windows with overall reference unit U-value of 0.74 W/m²K

Heating: Vaillant EcoTEC Plus 825 combi gas boilers to each house, providing space heating & hot water. Space heating distributed via low temperature radiator system with TRVs, linked back to one central thermostat.

Ventilation: Paul Novus 300 MVHR systems to houses and some ground floor flats, Paul Novus 200 MVHR to other flats with Paul electric heating batter to intake. Passive house certified heat recovery efficiency of 93-94% & 91% respectively.



FLAT PACK HIJACK



Flat-pack furniture has become a fixture of modern living, but what happens when the same concept is applied to housing – and when the client is an architect seeking to build to passive house and nearly zero energy building levels?

Words by John Cradden

€110

per month
(including all energy use)

Building: 186 m² offsite-built detached house
Location: Carrickmines, Dublin
Completion date: February 2019
Budget: €450,000
Standard: Near-passive/ NZEB

“

I knew it was very high spec in terms of insulation and airtightness.

If this newbuild in south Dublin proves anything, it is that a new timber-based build system which defies categorisation is suited to meet the passive house and nearly zero energy building standards, while bringing advantages in terms of speed of construction and quality.

Designed as a four-bed house but with one of the rooms converted into an multi-purpose entertainment centre, this sleek-looking, detached, single-storey dwelling in Carrickmines, Dublin, has achieved an A2 BER along with NZEB compliance, and comes within a hair's width of meeting the passive house standard. It also shows just how far prefabrication technology has come.

Indeed, if you've done any research recently on the new build market, you might have noticed that off-site, factory-built systems have been gaining some considerable traction in a construction marketplace still dominated by on-site, masonry methods.

Even conventional timber frame construction itself is still relatively niche in a country overly disposed to blocks and mortar, but the fast-moving evolution of off-site, rapid-build technology enabled it to grow market share here to up to 35% during the Celtic Tiger years — though as with all construction at the time, the quality was mixed, to say the least.

There's also the relatively negative association many Irish people attach to the word

'prefab', thanks to memories of being taught in cold, draughty temporary buildings at school. Of course, the lifespans of those buildings were measured in years rather than decades, but even ostensibly temporary systems erected for new schools today seem a world away from those soulless grey boxes, both in terms of their outward appearance, how they feel inside and their longevity.

The two big advantages of off-site systems these days are speed and the potential to achieve high quality. With most of the work done in a factory, it reduces the amount of time needed on site to finish off. The factory environment that makes the greater economies of scale possible also enables greater quality control, particularly in relation to insulation, airtightness and fittings.

This home's client, Lisa Wynne, is an architect herself, specialising in commercial buildings. She had wanted to build a top quality, energy efficient home from the outset. "I wanted to do it as well as possible, and I don't see the point in cutting corners." She had already intended to specify elements like triple glazed windows, but when they looked at doing things to passive house standard, "it seemed like it wasn't that much of a stretch," she says.

Basing their newbuild on structural timber construction was very much a priority, and they had looked at various systems, but the

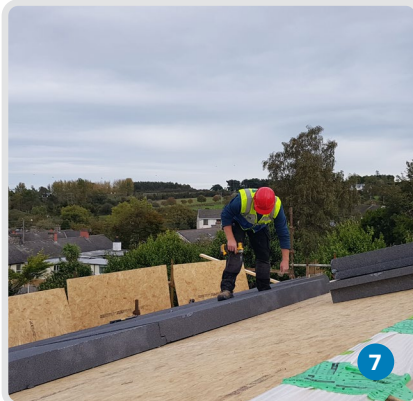
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The digital magazine is available to subscribers on www.passive.ie



CONSTRUCTION IN PROGRESS



1 The ground floor features a Kore EPS insulated formwork foundation system; **2** laying pipes for the underfloor heating system (in white) and ducts for the ventilation system (in blue); **3** erection begins of the Glavloc G Loc Zero external wall system; **4** the rapid-build system features 90 mm EPS70 wall insulation between the two OSB3 racking boards; **5** closing and insulating the window reveals; **6** the build system also features 125 mm KORE platinum EPS70 external insulation; **7 & 8** a further 150 mm grey EPS70 is installed over OSB sheeting on the roof; **9** further external insulation being installed; **10 & 11** construction of the Glavloc system well under way, with large openings left for the glazing; **12** pro clima Intello membrane to wall and ceiling, with airtightness taping.

tricky access to their site generated a few issues for potential suppliers.

The site was once the enormous back garden of a cottage owned by the parents of Lisa's partner Keith. His parents recently sold the cottage and were also looking to build a new house on the site.

But the difficulty in getting timber frame system suppliers interested in either job was compounded by the risks for the family of the long lead-in times for hiring cranes. "With the lead-in times, you might miss the slot and if it's a windy day, you're still paying for the crane," says Lisa. "You could be paying for a crane for a week and not get the job done."

Working with Paul Doran of leading passive house builders Pat Doran Construction, the idea of using a system by Cork-based firm Glavloc came up. "Because the site was tight [to] access, I thought this was a good choice as you don't need a crane," says Doran. "You can stick all the materials into a transit van, and you could walk them onto the site. Also, I knew it was very high spec in terms of insulation and airtightness."

A timber system that goes up like Lego

The Glavloc system doesn't need big cranes to erect because the structural components are designed to be put together a bit like Lego. According to Glavloc founder and managing director Paul Glavin, the company has broken down its timber structure to roughly 12 standardised components that are all cut out of engineered timber and clipped together to form whatever structure is required.

"So in our factory we manufacture runs of 8,000-10,000 of these components at a go and then we stack them in a warehouse and as buildings come in, we then work out how many of each component is needed, they're flat-packed, taken to the site and put together onsite into wall panels."

Lisa was initially sceptical, but open-minded about using Glavloc. The couple travelled to the company's base in Cork to check out some Glavloc buildings; one that was under construction and another that was fully finished.

"When I saw it onsite I was quite impressed with it, because it's a lot more kind of solid than you'd expect," she says. The speed of construction was another plus point, with the promise of completion in a matter of weeks rather than months. "It was kind of hard to believe. I'm a commercial architect so I know how long things generally take to happen, and then I was also impressed with the fact that they're an Irish company."

Keith's parents opted to go with the Glavloc system too, and they got their smaller 130 m² three-bedroom house completed first (also designed by Lisa and built by Pat Doran Construction) before Lisa and Keith embarked on their project.

The two houses look quite similar on the outside but are very different on the inside, not least in terms of size. "They wanted an open plan living area which I wouldn't be keen on myself, but they use their house a lot differently than us," Lisa says.

Keith's parents also only spend six months



“

The structural components are designed to be put together a bit like Lego.

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of the year in Ireland, and while their building did not aim for the passive house standard, what the two houses do have in common is that their living rooms are both south-facing. One disadvantage of prefabricated systems though is that they are difficult to modify once the frame is finished and onsite, something that Lisa was well aware of.

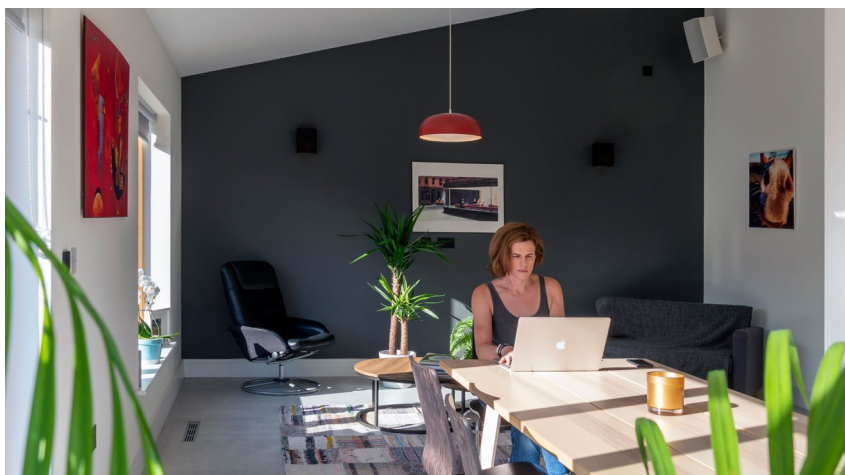
"Ideally you'd want to pick the system first and then design the house; that would be the best way to go. But when I looked at the constraints of the system on the module side, we were able to adapt it quite easily without really changing the design intent at all." She adds that Paul Doran was very accommodating about their desire to have sloped ceilings, a tricky job.

Doran says: "On that house we got the walls up in one week, then the roof in the second week but that was a very complicated house; in a more standard house you'd do it all in one week."

The fact that the house was designed before the decision came to aim for the passive house standard meant its building form was not optimised, making it trickier to meet the required benchmarks. However, with a heat load of 11 W/m² in PHPP (the passive house design software), the house comes within a whisper of the 10 W/m² required for certification.

In terms of its performance, Glavin says the Glavloc system was originally designed to exceed passive house requirements, with U-values starting at 0.14 down to 0.12 W/m²K, while it is also one of the few companies that are certified to add external insulation in the factory, with EPS in between the studs as well as on the outside.

"So not only are the U-values very good, but the cold-bridging factor is also extremely low on the actual building in all." (The house's



final airtightness result was also a superb, passive-beating 0.34 air changes per hour).

Glavloc is also set to shortly gain NSAI Agrément certification to confirm that buildings made with the system can expect to have a lifespan of over 60 years.

Leading passive house designer John Morehead of Wain Morehead Architects was brought in to advise on the passive house requirements. While Lisa's house uses a higher grade of EPS, there is not much difference in the basic kit, according to Glavin. The extra work required centred more around the requirements of airtightness and detailing.

"It's similar to any other detailing of a timber frame building; you just have to put the time into it and get the actual results raised," says Glavin. "From our point of view, it was more validation of what we were doing rather than maybe learning a huge amount from the actual process."

The promise of an exceptionally speedy construction time from July 2018 to last Christmas didn't quite materialise thanks to delays on the supplier side. But since moving in some six weeks into 2019 (and still well within the throes of winter), the family are delighted.

"It's always about 23, 24 degrees in here, so it's just very comfortable," says Lisa. "Like you get up in the morning you don't know what the temperature is outside because you don't really feel it; it's a shock to the system in the winter."

This, together with the high ceilings and lots of glazing, have proven a huge contrast to their old "cave" of an ex-council house in Sallynoggin, with its small windows that you couldn't see out of properly, and indoor temperatures that were often colder than the outside. Despite being close to Carrickmines now, "we're sort of in the countryside which is lovely...it feels a little bit further out of town."

And even though her mother-in-law's house is built using a Glavloc system albeit with some crucial differences, the contrast between the two new neighbouring homes is significant. "It's completely different. It's a totally different feel about it. The space here is a lot different."

The only negative from a running cost point of view has been with building insurance, which is a problem for some timber-framed

homeowners (particularly those with no block or brick outer leaf). "It's more difficult to insure," says Lisa, "since you have to go through a broker because it's considered 'non-standard construction', because there are no concrete blocks used in the building. They can't get their heads around a building that has no concrete."

But if the quality of this house is any indication, it can't be long before we'll see more folks get their heads around the idea of living in homes built using highly engineered, factory-built systems.

SELECTED PROJECT DETAILS

Client/architect: Lisa Wynne

Passive house consultant:
Wain Morehead Architects

Assigned certifier:
Ryan & Lamb Architects

Main contractor: Pat Doran Construction

Building system supplier:
Glavloc Build Systems

Civil & structural engineer:
Tanner Structural Designs

BER assessor: Accent Energy
Insulation: KORE

Windows & doors: Munster Joinery

Space heating & ventilation: Nilan
Powder coated aluminium roof:
Alupress

Slates: Tegral

Breather membranes: Dupont Tyvek

OSB: Medite SmartPly

Airtightness tapes & membranes:
Ecological Building Systems/ Isover

Larch cladding:
Machined Timber Specialists

External insulation system: Tradecraft

Heating & ventilation: Nilan Ireland



Read more about this project in detail

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13A, the first of the two houses built on site, and (right) an angle showing the proximity of the two houses



IN DETAIL

Building type: Single-storey detached 186 m² offsite-built near-passive house (13B). Second 130 m² low energy/NZEB house built on same site using same build system (13A). All details below relate to 13B unless otherwise stated.

Location: Carrickmines, Dublin 18

Completion date: February 2019

Budget: €450,000 (13B)

Passive house certification: Pre-submission

Space heating demand (PHPP):
23.06 kWh/m²/yr

Heat load (PHPP): 11.21 W/m²

Primary energy demand (PHPP):
90.03 kWh/m²/yr

Heat loss form factor (PHPP): 3.11

Overheating (state calculation tool, e.g. PHPP): 1% (of hours above 25°C)

Energy performance coefficient (EPC)
13B (passive house): 0.281
13A (non-passive house): 0.25

Carbon performance coefficient (CPC):
13B: 0.264
13A: 0.235

BER:
13B: A2 (47.25 kWh/m²/yr)
13A: A2 (47.27 kWh/m²/yr)

Environmental assessment method: N/A

Airtightness:
13B: 0.34 ACH @ 50 Pa
13A: 1.04 m³/hr/m²

Thermal bridging:
0.08 W/mK (default value in DEAP)

Energy bills (13B): Lisa Wynne told us her electricity bill averages about €110 per month, which covers space heating, hot water & all electricity.

Ground floor (13B): Power floated finish to concrete floor slab, followed underneath by reinforced concrete slab, combined DPM/radon barrier, radon sump, EPS200 & EPS100 insulated formwork, 50 mm binding, 200 mm to 300 mm of well-compacted hardcore. U-value: 0.09 W/m²K

Ground floor (13A): Raft foundation 150 mm EPS 100. U-Value: 0.120 W/m²K

Walls (13B): Glavloc G Loc Zero external wall system, comprised of (variously) larch cladding on ventilated cavity or Parex Lanko render system; on 125 mm KORE platinum EPS70 external insulation; on Glavloc breather membrane, 18 mm OSB3 Glavloc racking board; 90 mm EPS70 wall insulation; 90 mm OSB3 Glavloc compression stud; 18 mm OSB3 Glavloc racking board; airtightness layer, 24 mm services cavity; 12.5 mm plasterboard. U-value: 0.14 W/m²K

Walls (13A): Same as above except featuring 150 mm white EPS. U-value: 0.14 W/m²K

Roof (13B): Gusclad box profile sheeting on 100 mm x 22 mm battens, on Tyvek supro breather membrane, on 18 mm OSB

sheeting, on 150 mm grey EPS 70, on 18 mm OSB sheeting, on 225 mm x 44 mm rafters at 400 mm, fully filled with 220 mm Isover Metac insulation, on Vario airtight membrane, on 50 x 44 mm timber batten service cavity, on 15 mm board and skim. U-value: 0.11 W/m²K

Sloped roof (13A): Tegral Thrutone slates on battens, on counter battens, on breather membrane, on 50 mm Xtratherm Thin R insulation, on 225 mm x 44 mm rafters with 220 mm Isover Metac between the rafter, on Vario airtight membrane, 50 x 44 mm batten for services, on plasterboard and skim. U-value: 0.12 W/m²K

Flat roof (13A): Fibreglass on OSB deck on tapered 150 mm EPS. on OSB Deck, on 225 mm x 44 mm joists with 220 mm Isover Metac insulation between, on airtight membrane, on battening for services, plasterboard and skim. U-value: 0.12 W/m²K

Windows (13B): Munster Joinery Passiv timber-aluclad triple glazed windows. U Value: 0.7 W/m²K. Ultra Tech triple glazed doors. U Value: 1.4 W/m²K

Heating & ventilation system (13B): Nilan Compact P combined air heating & cooling and heat recovery ventilation system, also producing domestic hot water from exhaust air. Passive House Institute certified. Also featuring Nilan Air9 air-to-water heat pump providing weather-compensated hot water to zoned underfloor heating circuits & capable of pre-heating domestic hot water when there is high demand. Integrated system designed to maximise the return from exhaust & only use the Air9 as a backup.

MIES EN SCÉNE

ICONIC DUBLIN OFFICES GET
DEEP GREEN TREATMENT



In brief

Building:

Deep retrofit of 21,800 m² office building

Completed: December 2016

Location: Baggot Street, Dublin

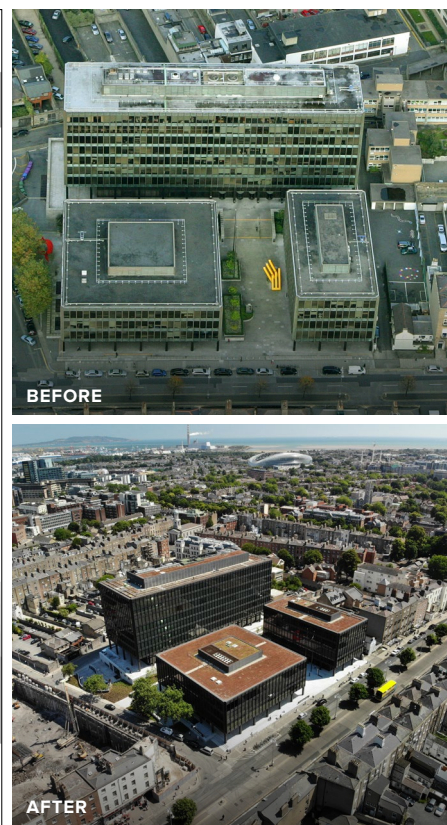
Budget: €100m

Standard: LEED Platinum V4

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The deep and comprehensive refurbishment of the Miesian Plaza complex on Dublin's Baggot Street provides a radical blueprint for how to transform mid-20th century city office buildings into comfortable, healthy and super low energy spaces that support sustainable transport and working patterns.

Words by John Cradden

When New York City published a list of the energy performance scores of the city's buildings in 2012, one essential piece of the city's architectural heritage was shown in a particularly poor light: Ludwig Mies van der Rohe's modernist classic Seagram building on Park Avenue scored just 3 out of 100. So, what on earth is a Seagram-inspired 1960s office building doing in the pages of a magazine on ultra-low energy buildings? What separates Dublin's Miesian Plaza from its forebear in this regard, is a hugely impressive effort to renovate and upgrade the office complex from the bottom to the top of the scale.

The developers have taken what would be described in industry parlance as a very 'hard to treat' commercial building and overseen its complete transformation into what is now one arguably of the greenest office spaces in the world.

What made the project even trickier from this perspective was the complex's status as a protected structure. Nonetheless, it's the first and only development in Ireland to date to be awarded LEED (Leadership in Energy

and Environmental Design) Platinum status – LEED's highest possible rating for environmental performance and sustainability. It joins an exclusive club of 180 other buildings worldwide that have achieved the same certification.

But it is also ground-breaking because it demonstrates the degree to which developers of commercial buildings are responding to increasingly strident client demands for vastly better energy performance, sustainability and comfort.

Miesian Plaza is a complex of three office buildings first designed and built in the 1960s and 1970s as the headquarters for the Bank of Ireland. It's well known for being one of the first modernist office buildings in the country, with its iconic fronted glazed facade and bronze cladding. It was also one of the first US-style 'central core' style buildings to be developed here, sitting on podiums above an underground car park.

In 2006, at the height of Ireland's property boom, Bank of Ireland sold the centre for €212m to a consortium of investors led by Derek Quinlan and Paddy Shovlin, but their

plans for the centre were disrupted by a combination of Dublin City Council's decision to designate it as a protected structure and the property crash (according to the Irish Times). Receivers took control and sold it to businessman Larry Goodman in 2012 for just over €40 million.

Goodman's Remley Developments then assembled an international design team led by Miesian Plaza's original architects, Scott Tallon Walker, to devise a €100 million plan to bring the 1960s and 1970s offices up to

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It was a very deep retrofit of the building and we had to dismantle it, really, and put it back together.

the highest standards, which included an extension to the rear of the largest block to create an overall floor space of almost 220,000 ft² of lettable space.

Block one is now out on long-term lease to three government departments — Finance, Health, and Children & Youth Affairs — while blocks two and three are occupied by Asian pharmaceutical giant Takeda.

Passive House Plus was given an exclusive tour of the facility by David Torpey, development director of Remley Developments. Standing in the slightly revised public space outside the buildings alongside the distinctive sculptures and water features, it's clear that things are different, but the plaza's essential character, particularly the bronze facade and curtain wall cladding, is still very much evident.

You might say it was fitting that Scott Tallon Walker were very happy to step in again on this project, given that its celebrated co-founder, Ronnie Tallon, was Miesian Plaza's original architect. Indeed, it turns out Ronnie Tallon himself took a close interest in the project when the plans were being drawn up before he sadly passed away in 2014.

It would be easy to be intimidated at the prospect of upgrading such a hard-to-heat building, built during an era when energy was cheap, but according to Paul Hadfield, one of the lead architects on the redevelopment, the building's good floor-to-ceiling height, its relatively modernity, and the quality of the materials used in the original construction lent itself well to being adapted and extended.

"From the outset originally, it was conceived as something that could be maintained over time," he says. "Now, obviously, it was a very deep retrofit of the building and we had to dismantle it, really, and put it back together in its entirety and demolish cores and rebuild them and re-introduce structure to get it to work. But the bones of the building, if you look at the building before it was renovated and then look at it again, it's the same."

Certainly, a hallmark of the original design was its symmetry, and the effort that the team made to preserve this is a striking measure of the attention to detail that went into the project. As an example, Torpey points out how the ceiling grid from Senior Architectural Systems and the location of the ceiling lights were set out to be gridded off against the facade so that there were no awkward juxtapositions that could be spotted by the naked eye, inside or out. This was a tricky enough challenge because the 1960s-era building was designed on an imperial structural grid.

"They were all great fans of symmetry," says Torpey. "Mr Ronnie Tallon, a great fan of symmetry. Mr Larry Goodman loves things to be symmetrical. All these things, they didn't happen by accident. There was a huge amount of effort put into the ceiling coordination and getting all of these set out in accordance with the primary grid."

The inside layout was subjected to extensive remodelling, including removing all the non-structural screed, which enabled the



team to put in raised access floors – a pretty much standard requirement for modern offices to ensure easy access to data cabling and other services.

Heating is provided by gas-fired fan coil systems, with additional Kampmann trench heaters along the perimeter of each floor – adding up to 2,000 metres worth – mainly to improve comfort levels for those sitting near the glazing. "All that's there to do, is on extremely cold winter days, is to make sure that there's no chill factor at the interface point there where the floor meets the wall," says Torpey.

The complex is beautifully finished throughout, with no hint of drafts or stuffiness, and was eerily quiet despite every floor being almost fully occupied. The same attention to detail is to be found in every part of the buildings, including the toilets, which are more akin to what you would find in a very posh hotel, with large, full-height cubicles, flattering lighting and super-efficient ventilation providing 20 air changes per hour. All toilet cisterns and urinals are fed by a rainwater harvesting system as well.

So, while the buildings have been significantly upgraded inside and out, how important was sustainability for potential clients? "It was huge", says Torpey. "You could say it was very much client-driven; the direction given from day one was to make this the most energy-efficient building it could be because that was seen by the owner as being an ever-increasing demand of tenants. And it's not going to go away. That was recognised."

Certainly, what becomes clear early on is that Remley's decision to aim for LEED Platinum (version four) status from the outset had a huge influence on the scope of the building's sustainability credentials. LEED is a rating system devised by the US Green Building Council, and it rates projects across six key categories: site sustainability, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality,



and innovation and regional priority (the latter covering any strategies not included in the other categories, or any particular concern in the building's locality).

According to Torpey and others involved in this project, LEED has more global recognition than BREEAM, (Building Research Establishment Environmental Assessment Methodology), which has a greater foothold in the UK and Europe.

Experts say there are pros and cons to both approaches, but LEED has more international recognition and certainly appears to be gathering more steam and challenging BREEAM in Europe. So, this, in tandem with the degree of US investment in Ireland, made the decision to go for LEED over BREEAM perhaps more of a marketing decision than anything else.

Mark Deverall, design co-ordinator at contractor John Paul Construction, says that setting LEED Platinum status as a target right from the beginning "was immensely beneficial and allowed us to plan accordingly to ensure the building would meet the determined targets".

"Our early involvement also meant we were able to explore the attributes of the various building materials to suit the targets and address any potential waste management issues."

Stringent energy performance targets are harder to achieve with a retrofit than with a newbuild, of course, but retrofitting an existing building can be beneficial in LEED.

"It can take more than 80 years to make up for the environmental impact of demolishing an old building and constructing a new one, even if the resulting building is extremely energy efficient," says US Green Building Council senior vice president Brendan Owens, who attended the certification presentation for the project.

"This is why LEED prioritises re-use of existing buildings as they are a critical part of making cities and communities healthier and more sustainable for residents... The work Miesian Plaza did to achieve LEED Platinum is a model for policy makers, design teams and developers to study and emulate."

On the other hand, the fact that all three of the buildings are protected structures presented a conundrum of tricky challenges in order to meet demanding energy use targets while still preserving their essential appearance and character.

According to Hadfield, the biggest challenge from the outset was the facade; given its protected status, there were restrictions on what could be done to it. Nonetheless, airtightness tests undertaken before works started showed that the facade leaked very badly, so there was considerable scope for improvement.

The curtain wall cladding, and double-glazed windows all had to be stripped and refurbished and fitted with new deeper CareyGlass glazed units. The new unit comprises an outer layer of bronze body tinted glass laminated to a pane of solar reflective glass, while the inner layer comprises two panes of extra clear glass so as not to alter the bronze hue (making four panes in total). The double lamination also provides redundancy should any of the panes break.

One of the best indications of quality of workmanship comes with the scrutiny of a blower door test. The three buildings posted impressive q50 results of 2.07, 4.53 and 4.62 m³/hr/m² @ 50 Pa. According to David Torpey, these results – and the attention to detail evident throughout the project – owe a lot to the approach the team took to meeting the Building Control Amendment Regulations (BCAR), working hand-in-hand with

leading independent assigned certification firm i3PT, who use a range of measures to track and record quality and compliance of construction projects. "Every piece of the facade, every piece of the EDPM that were put in was inspected and photographed."

i3PT's environmental manager Archie O'Donnell says the project's success didn't happen by accident. "The culture on a project happens top down from the owners, the project manager, the contractor. That permeates through the project to the guys on the tools. David Torpey set a very clear objective that everyone could roll in behind."

Meanwhile the corners of the south, east and west elevations of the buildings are fitted with a second, inner double-glazed skin, with a 600 mm ventilated cavity between this and the outer glazing. Ventilation slots at the base and head of the outer glazing are designed to allow for passive ventilation of the cavity, to help prevent thermal build up, while there are also motorised solar reflective blinds governed by roof-mounted weather stations.

As well as giving excellent heat and sound insulation, Torpey says these twin walls will also give clients greater flexibility with regards to remodelling without needing expensive alterations to the base infrastructure at a later stage. "So, the decision was made, and it cost a lot of money both in terms of putting it in and losing some floor area, but we made that decision. We were either going to say that these buildings were of a particular standard or they weren't."

The upgraded facade was crucial in reducing heating and cooling requirements and was a significant boost to the energy efficiency, accounting for almost half of the 77% reduction in energy demand. To put this further into perspective, the overall energy demand today of 144 kWh/m²/yr – simulated in the IES Virtual Environment software – is a far cry from the 457 kWh/m²/yr the pre-retrofit building was scoring in LEED.

As well as the bronze in the facade, there was also bronze in the inside of the building, but it was in a much worse state than on the facade, so the decision was taken to replace it with new aluminium capping but anodized

in bronze. Working with Dublin City Council, Scott Tallon Walker produced no less than nine different sample panels to find the best match of tinted glass to the original bronze tinting.

The original bronze blinds were replaced with white blinds which have a bronze coating at the bottom to preserve some of the original aesthetic and which are, unusually, concave rather than convex.

Given that this was a five-year project that started in 2013 in earnest, it's worth noting that Remley went out of their way to source materials with EPDs (Environmental Product Declarations) at a time when practically nobody else in the country was looking for them – a full three years before the Irish Green Building Council launched the EPD Ireland register of audited construction products.

Complying with LEED also requires proper documentary evidence. "We had to show them, in terms of the disposal strategy that 95%, both by volume and weight, did not go to landfill, it was recycled," says Torpey. "So, for instance, all of the original carpets that we had here, they all went for recycling."

The development is heated by a combination of modulating condensing gas boilers, along with a gas-fired CHP in block one, which collectively provide low temperature hot water to fan coil units and trench heaters in the offices.

Meanwhile the energy load for cooling is significantly reduced by a thermal energy store from Crystal Air PCM, using phase change materials (PCM) which change from liquid to solid state using Pluss OM11, an organic

“

It's the first and only development in Ireland to be awarded LEED Platinum.





PCM with a melting point of 9.5C, to operate with standard chilled water flow and return temperatures (6/12C) and enable the next day's cooling load to be generated efficiently and economically at off peak electricity rates – and stored till required. The operation of all the heating and cooling kit for the buildings is watched over like a hawk by building manager Sarah Burns – the tour for Passive House Plus included a building management nerve centre with a multitude of live and logged data available on the building's performance.

Another impressive feature at the ground floor basement level is the separate bicycle hall with its own dedicated entrance and space for 225 bikes – full of bicycles on the day Passive House Plus visited – plus a super-ventilated, underfloor-heated drying room (for wet and sweaty gear) and even a couple of fully equipped service stations for fixing bicycles, and a rainfall radar display to keep staff ahead of the weather. There's also a well-equipped gym and showers. The underground car park spaces are a bit wider than standard and include six charging stations for electric vehicles.

The provision of these facilities goes well above and beyond what was required by the LEED certifiers, but Torpey says the certifiers were “gobsmacked” when they saw them. “But what they were most gobsmacked about was the use [of the cycling facilities] ...you can see the use and how popular it is. I would say that if you do give the correct level of infrastructure, people will use it.”

The heating system has been also been broken up into multiple zones for greater flexibility, which means being able to localise usage at quieter times, such as at the weekends.

But from the perspective of working with tenants to ensure that the building's energy performance is optimised, securing leases of 20-25 years is key. “The benefit of that is, is that we cannot quite dictate, but most certainly direct and encourage tenant compliance with our preferences with regards to that environment,” says Torpey.

Whereas other landlords might “cut the ribbon and walk away”, Remley believes it can assist tenants to get the most out of

the building. “It doesn't come from a single meeting. It doesn't come from a statement. It comes from working together, analysing the core data.”

As a finished product, Hadfield says the project has revitalized not just the buildings but the space around it. “It feels like part of the city again; before it felt like it was slightly being pulled away from the city because it hadn't been used as much in the last, say, 10, 15 years.”

“But I think the biggest takeaway, really, is that you can achieve so much with an existing structure providing the quality is there in the first place.”

According to Archie O'Donnell of i3PT, it shouldn't be surprising that a rigorous approach to meeting BCAR – in this case with an independent, scrupulous assigned certifier implementing a systematic approach to compliance, and maintaining an evidence trail – should help to achieve a high-performance building.

“BCAR interfaces with energy efficiency and passive house because the objectives are the same – the BCAR process is synonymous with quality. If you hadn't a regime you should still be delivering those quality objectives. Where construction quality and passive house overlap is in that outcome-focused approach – where designs are reviewed and co-ordinated, materials and methodologies are checked, installation works are inspected and supervised and performance at completion is verified with detailed records collated as evidence of the good work done.”

But will such a strong focus on quality and sustainability become a more common feature in commercial building designs? David Torpey sees a strong demand for sustainability among his client base, including the kinds of multinational corporations looking for high-end European office accommodation. “The market expectation in Washington at the moment is that if it's not LEED Platinum, then it's not for us,” he says. “There should be no fear within the sustainability community that there isn't an understanding and an acceptance from the commercial side. We accept that this is absolutely a base require-

ment from our tenants. Not just for sustainability but in terms of occupancy costs, staff comfort, and their staff enjoying working in the building.”

SELECTED PROJECT DETAILS

Client: Remley Developments

Architect:

Scott Tallon Walker Architects

Main contractor:

John Paul Construction

Assigned certifier: i3PT

Civil & structural/M&E engineer/

environmental consultant: Arup

LEED consultant: JAE Engineering

LEED assessment: Longfields

Quantity surveyor:

Kerrigan Sheanon Newman

Fire consultant:

Michael Slattery Associates

Planning consultant: Stephen Ward

Town Planning & Development

Airtightness testers:

Building Envelope Technologies

MEP installation:

Designer Group/Winthrop

Glazing & cladding contractor:

Architectural Aluminium Ltd

Glazing system: CareyGlass

Air handling units: FläktGroup

Fan coil units & trench heaters:

Keane Environmental

Condensing boilers: Hevac

CHP: Temp Technology

Building management system:

Ashdown Controls

Facade management system:

Crossflow

Thermal energy store: Crystal Air PCM

Rainwater system: Capcon

Internal paints: Keim/Dulux

Render system: Sto

Wool insulations:

Rockwool/Isover/Knauf

Gypsum boards: Gyproc

Flooring: Interface/Forbo

Read more about this project in detail

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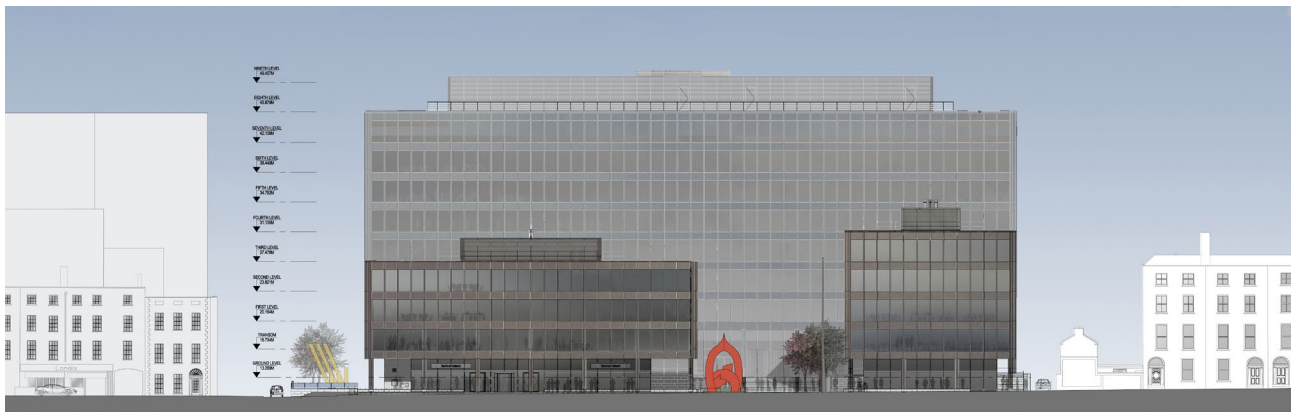
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IN DETAIL

Building: 21,800 m² office building (Grade A)

Location: Miesian Plaza, Baggot Street, Dublin 2

Completed: November/December 2016 (tenant fit-out followed this)

BER: Not required (listed property)

Environmental assessment method: LEED Platinum Version 4 certified

LEED Energy Model for proposed building: 144 KWh/m²/yr (net delivered energy, including regulated (space heating, hot water, ventilation, cooling, lighting and unregulated loads (plug loads, lifts, etc). Based on standardised occupancy profile.

LEED Energy Model for original building: 457 KWh/m²/yr (used for comparison to determine LEED energy cost savings)

Calculated primary energy demand: (iSBEM, primary energy, regulated loads)

Before: 400 kWh/m²/yr

After: 100 kWh/m²/yr

Energy bills: Not available

AIRTIGHTNESS

Before: Not available though it was known the façade leaked badly

After (at 50 Pascals):

Block 1 q50: 4.62 m³/hr/m²; n50: 0.89 ACH

Block 2 q50: 4.53 m³/hr/m²; n50: 1.27 ACH

Block 3 q50: 2.07 m³/hr/m²; n50: 0.61 ACH

(Note q50 results are as per airtightness test, n50 results were calculated by Greenbuild for Passive House Plus based on q50 results and gross building volumes and are estimates only).

Ground floor:

Upgraded to U-value: 0.20 W/m²K

Roof: New extensive green roof with tapered rigid insulation board with minimum U-value of 0.20 W/m²K

CURTAIN WALLING (before)

- Non-thermally broken semi-unitized bronze

curtain walling system, incorporating floor-to-ceiling bronze body tinted double glazed units, and bronze clad spandrel panels between the first-floor level and roof.

- Non-thermally broken stick bronze curtain walling system, incorporating an upper and lower row of double glazed units between the ground floor level and the soffit of the first-floor level.

U-value (centre pane glass only): 2.9 W/m²K

U-value (glass + spandrel + framing): 3.8 W/m²K

CURTAIN WALLING (after)

Cladding upgrade works comprised the following:

- asbestos removal from the existing spandrel panels
- insulated backing panel to the existing spandrel panels
- floor edge thermal insulation infill
- new fire break detail
- new CareyGlass double glazed units, comprising four panes of glass (outer laminated bronze tinted/solar reflective panes, argon filled cavity, inner laminated extra clear/extra clear panes)
- new thermally broken and insulated inner bronze anodized aluminium capping and framing
- new outer weather seals
- new inner seals and membranes to provide second line of defence from a weathering prospective
- new weep holes to the existing carrier frame to allow for drainage, pressure equalisation and ventilation of the double glazed units

U-value (centre pane glass only): 1.0 W/m²K

U-value (glass + spandrel + framing): 1.65 W/m²K

Note: An extension to block one was constructed using a structural steel frame and the same facade system as outlined above.

HEATING SYSTEM (after): The buildings are provided with a four-pipe fan coil system for heating throughout (developer standard fit-out). Natural gas fired boiler plant is used to generate low temperature hot water (LTHW). Gas plant comprised of 3 x De Dietrich boilers in Block 1 (1 x C330-650 ECO; 2 x

C630-1300 ECO); 2 x boilers in Block 2 (De Dietrich C330-280 ECO) and 2 in Block 3 (2 x De Dietrich C330-430 ECO).

Low temperature hot water is pumped to each floor of the three buildings and valved and capped on each floor shafts and provided with heat meters for use in above ceiling fan coil units (developer standard fit-out) which provides heating to the floor plates. Perimeter Kampmann trench heaters are provided throughout all three blocks. All connections are metered.

Ventilation: Series of FläktGroup air handling units (AHUs) to each block. All AHUs treat and distribute fresh air at a rate of 14 l/s/person (one person per 8 m² net floor area), to all office areas (to two separate locations on each floor, in all three blocks). Vertical ducts carry fresh air to and extract air from all floors. The AHUs are fitted with chilled water and hot water coils to temper the incoming, filtered, outside air. AHUs incorporate thermal flywheels for heat transfer.

Thermal energy store: A 1,000 kW thermal store contained in 5 insulated vertical tanks filled with savE phase change material (PCM), manufactured for Crystal Air by Pluss Advanced Technologies, encapsulated in hermetically sealed HDPE crystal spheres for the storage and transfer of the buildings' thermal requirements – with cooling generated at night making use of off-peak grid electricity, for both fan coil units and air handling units.

Electricity: Block 1 features a gas-fired 75 kW ENER-G combined heat & power (CHP) plant.

Water: Rainwater collection tanks are located at basement level of each block. Booster pumps distribute filtered rainwater for WC flushing.

Green materials: A broad range of products with EPDs were specified from brands including Besam, Dorma, Dulux, Forbo, Gerberit, Gyproc, Hilti, Interface, Isover, Kiem, Knauf, Mosa, Norament, Promat, Rockwool, Senior Architectural Systems, Sto, Uzin, Ventec, Wavin, etc.



DOCTOR'S ORDERS

THE COMPLEX RELATIONSHIP BETWEEN ENERGY RETROFITS & HUMAN HEALTH

There is no shortage of anecdotal evidence that home energy retrofits, done well, can improve the health of those who receive them — and equally there are horror stories about shoddy upgrades causing damp, mould and illness. But what does the evidence say about how energy upgrades effect occupant health, and what lessons can be learned for the future of how we renovate our homes? *Kate de Selincourt* reports.

In July, the House of Commons Business, Energy and Industrial Strategy Committee released a report which was highly critical of the current lack of progress in building energy efficiency work, particularly in England. The report urged a seven-fold increase in the installation rate.

“A major upgrade of the energy performance of the UK’s entire building stock will be a fundamental pillar of any credible strategy to reach net zero emissions, to address fuel

poverty and cut energy bills,” the committee told the government.”

This report followed close on the heels of the Committee on Climate Change’s recommendations for new and existing homes which, unsurprisingly, also urged the government to increase the uptake of energy efficiency measures.

Whether or not the UK government chooses to act on this advice is anyone’s guess. However, if it does, there are expected

to be numerous benefits besides emissions reduction. One of the obvious benefits would be improved public health.

A calculation by BRE that poor housing in the UK costs the NHS £2.5bn per year is often cited. The assumption is that fixing the housing will avert this expenditure – a reasonable assumption, given the strong association between poor health, and excess winter deaths, with poor quality housing. However, this is only an assumption.

Anecdotally, there is evidence that home energy improvements can indeed improve health. For example, when social landlord Gentoo began to replace boilers and insulate tenants’ homes, they were struck by how often customers said their health improved.

“Families reported being happier and their wellbeing had increased. Not just in one or two homes, but in home after home, street after street. We were being inundated with huge amounts of anecdotal evidence to suggest the biggest difference we had made

since retrofitting the home was to the health of our customers.”

Gentoo attempted to put numbers on these effects. They studied the impact of their energy efficiency installations more systematically – and found that across 200 hundred households where boilers and windows had been upgraded, tenants on average said they felt healthier and used the NHS less (equivalent to around a 15% reduction in spending per household compared to before the improvements).

This is far from the only study to recorded positive health outcomes from home energy interventions. Researchers asked tenants of Nottingham City Homes about their health and satisfaction before and after the external wall insulation was fitted. They too said their health had improved, with statistically significant improvements in mental well-being, including reduced anxiety, and reduced use of NHS services.

Meanwhile, charity National Energy Action (NEA) co-ordinated a range of heating and insulation measures for several thousand fuel poor households living in inefficient dwell-

ings, and over 700 were asked about their experiences before and after the measures were installed. Over a third said their physical health had improved, with just a few (6%) saying their health had worsened, and the rest reporting no change – in other words, a trend towards better health after energy retrofit.

There are many studies like these, and a fair number of them do report health improvement, though not all. But there have been criticisms of the research methodologies: not all have a control group for comparison, so unconnected factors, such as one winter being milder or harsher than the next, cannot always be ruled out as the cause of any changes in health.

Also, unlike with placebo-controlled trials in medical research, people always know if they have had their boiler replaced or their walls insulated, so their expectations may be affecting their health, or their perception of it – especially if they are being specifically asked about it.

There are also studies that have shown little or no measurable impact. And even though researchers generally advance a plausible

explanation for why this might be – numbers too small, follow-up period too short, etc – the suspicion has to remain that some improvements simply do not make much difference to occupants’ health.

Biggest study to-date

Probably the most convincing positive results to date are a set of studies that looked at different aspects of the health of a group of 30,000 tenants of a single social landlord and studied some for up to ten years.

This group of studies is valuable because it involved so many people, which increases the statistical power of the findings, and the follow-up period was far longer than is usually possible in research of this kind, again making it likelier that any health effects seen were not just a temporary boost based on expectations.

Perhaps most powerful was the fact that, uniquely for a recent study in the UK, the researchers had direct access to people’s (anonymised) medical records, so were able to compare the health service use of all 30,000 occupants (it would have been impossible to interview so many people).

RETROFITTING FOR AIR QUALITY

Replacing open fireplaces, stoves or ranges burning solid fuel with a central heating system that brings comfort at the flick of the switch has been demonstrated in some of these studies (for example, the work from Northern Ireland) to bring benefits to householder health.

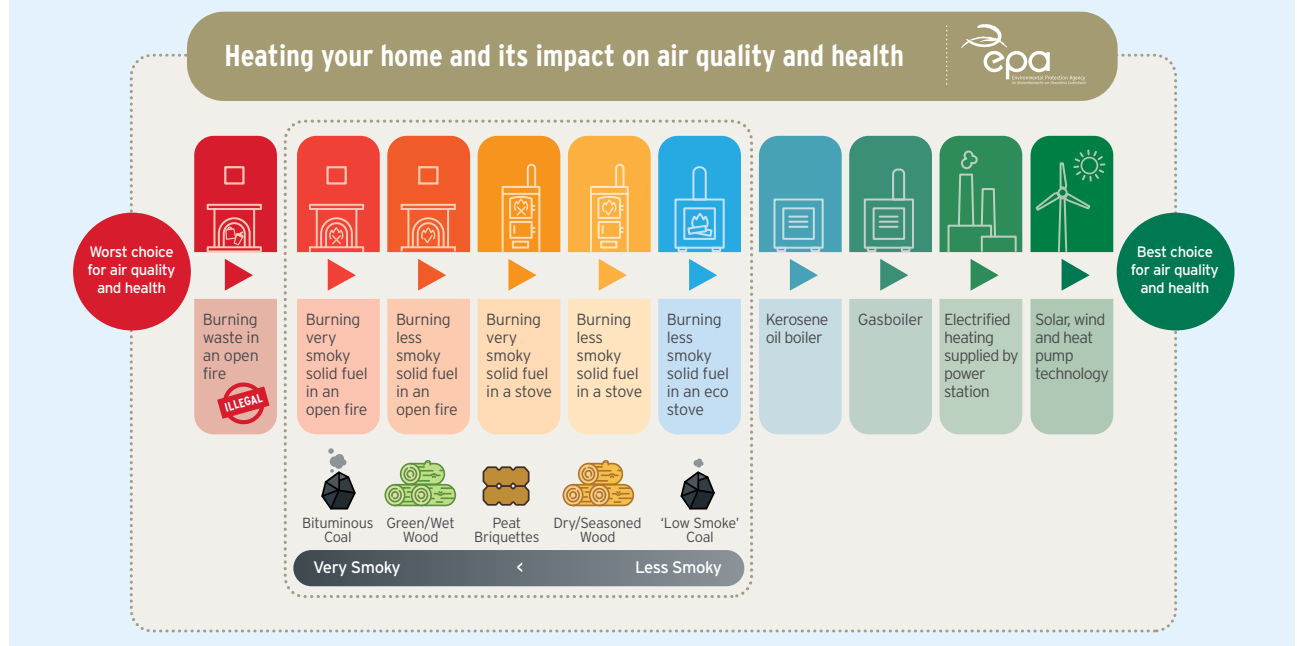
None of the studies referred to in the main article recorded indoor pollutants other than moisture, and they did not measure indoor air quality in the study homes. But it is interesting to consider whether eliminating a source of smoke and pollution from people’s homes may have played a part in improving

their health.

Solid fuel burning is a source of many toxic and irritant pollutants, and Ireland’s Environmental Protection Agency has recently published monitoring data showing that levels of carcinogenic polyaromatic hydrocarbons (PACs) derived from solid fuel combustion (coal, wood and turf/peat) exceeded EU reference levels at several test locations last year. Solid fuel combustion, notably in wood stoves, is also a significant (and growing) contributor to particulate pollution in the UK, accounting for as much as 30% of locally produced particulates in some cities.

Domestic solid fuel burning introduces harmful air pollution into dwellings both directly, and also when ventilation air from outside is contaminated with chimney smoke – which it generally will be, to a greater or lesser extent.

It is therefore plausible that some of the health benefits enjoyed by the recipients of new central heating systems came via reductions in pollutants such as particulate matter, NO₂ and SO₂. While there is no evidence on this either way, it is also worth noting replacing solid fuel heating with something cleaner benefits not only the recipient, but the whole neighbourhood.





“

Elderly occupants of homes with upgraded ventilation, CO monitors & fire alarms were admitted to hospital 39% less often – with a 57% drop in emergency admissions for respiratory illness.

The landlord, Carmarthenshire County Council in Wales, carried out a wholesale home improvements programme to bring all its homes up to the Welsh National Housing Standard. The measures installed varied dwelling-by-dwelling, based on what each needed. Improvements included insulation, heating upgrades, new doors and windows, and because falls at home are a major cause of injury and hospitalisation, improvements to paths and steps.

The researchers were therefore able to look directly at impacts on NHS spending. It was also possible to compare different subsets of tenants according to which changes had been made to their homes.

The main part of the study looked at emergency admissions to hospital for respiratory and cardiovascular problems, plus falls and burns – for all residents, but with a focus on those over 60. Residents over 60 living in homes where improvements were made went to hospital significantly less compared with those living in homes that were not upgraded.

Admissions to hospital fell by between one quarter and one third across the improved homes, depending on the measures that had been installed. Strikingly, the biggest improvement of all was seen in homes where the electrical system had been upgraded – an upgrade that included carbon monoxide monitors and fire alarms, but also ventilation. In these homes, occupants over 60 were admitted to hospital 39% less often after the measures were installed, and there was a 57% drop in emergency admissions for respiratory illness in particular.

Indoor air quality

Anyone working with people in fuel poverty knows that cold homes are often damp as well, yet moisture and indoor air quality have not been a prominent concern in the mainstream UK energy efficiency programmes to date.

Damp is known to harm health, independently of cold. In some analyses, damp seems to be more closely related to harm than cold does.

WHO IS MOST VULNERABLE TO COLD?

It is well-established that the risk of cardiovascular disease, and respiratory diseases such as asthma, are more common for people living in housing that is hard to heat. Illness and death rates from these conditions increase in winter – and increase most for people in the worst housing and in the worst poverty (all too often the same people).

Less well-recognised is the fact that dementia sufferers are equally vulnerable to cold – in fact excess winter deaths from dementia in some years outnumber excess winter deaths from heart disease. While dementia may or may not be made more likely by cold housing (there has been remarkably little research on this) dementia sufferers in cold homes are particularly vulnerable to just getting too cold, with the harm that then ensues.

Dementia sufferers may be both less likely to notice they are cold, and less able to work out what to do about it. Sufferers often forget to eat, too. Falls in cold conditions, when the person is alone and lies undiscovered for many hours on a cold floor, are particularly dangerous and can lead to a severe deterioration in health, or even death. Living in a home that you can't afford to heat also makes a whole range of other health problems likelier in the first place, and it makes many existing conditions worse.

Living with a physical health problem or disability can also make it harder to cope with the cold: if you have mobility problems or a reduced appetite you

are likely to feel the cold a lot more (but ironically, are quite likely to be stuck in that cold house more of the time). And if your home is cold and your income is low, the practicalities of dealing with illness and disability – for example, doing more laundry – will become harder too.

Problems that have been highlighted as making cold especially tough include spinal injury, arthritis and rheumatism, sickle cell disease, skin problems, cancer treatment and recovery – but it is hard to imagine any condition that is going to be improved by living in fuel poverty.

And yet, cruelly, having a long-term illness or disability makes you a lot likelier to be in fuel poverty – not least because your income is very likely to be constrained. Fuel poverty rates for disabled people in the private rented sector are particularly high: 35% of UK households with a disabled occupant are in fuel poverty.

There is also a particularly close link between poor housing and poor mental health. Data from the Adult Psychiatric Morbidity Survey 2007, a survey of 7,400 people in England, showed that being unable to heat your home in winter, having a combination of fuel debt and other debt, having mould, and restricting energy use were all predictors of mental disorders such as depression or anxiety. Research by the World Health Organization found that extensive dampness and mould at home increased the chance of depression by 60%.

So, it is perhaps unsurprising to learn that ventilation, alongside energy efficiency measures, has a beneficial impact on health. This has been seen in other studies – smaller ones, often targeted specifically at people with respiratory conditions (often children). In these cases, the installation of ventilation, sometimes alongside heating, has been associated with reductions in symptoms and in fewer days missed from school.

Warming a house can help with dampness to an extent, especially with dampness exacerbated by cold (it won't repair a leaking gutter). When a home is warmer, people are more likely to ventilate, and surfaces may be warmer and attract less condensation.

In studies where very old, cold homes have central heating installed, damp has often been reported to reduce. In one study in rural Northern Ireland, three quarters of unimproved homes reported condensation, damp or mould – but in half of these the problems were alleviated after the installation of new heating systems.

Other intervention studies have also found that homes became drier after new heating or other energy retrofit measures were installed. But this is not always the case.

For example, in a survey of people who had had their homes improved under the NEA charity's health and innovation programme, participants consistently reported that their homes were warmer or at worst, the same as before. But the responses relating to damp and condensation were more equivocal. Although more people agreed there was less damp and condensation after the retrofit, the difference was not overwhelming, and quite a few disagreed with the proposition – suggesting that while energy efficiency measures may tend on balance to reduce dampness, they are not always enough on their own.

Many retrofit measures reduce air leakage – sometimes this is the main objective – so if existing ventilation is already inadequate, as it so often is in British housing, new problems may arise.

A small study of indoor conditions after retrofit by researchers at Cardiff University illustrates this. When new mechanical ventilation was installed, internal humidity did not rise even when homes received measures that may be likely to reduce air infiltration, such as external wall insulation. However, in a subset of the dwellings where ventilation was not installed, but other measures such as new windows were, there was a small rise (around 5%) in relative humidity.

This is concerning, especially when seen alongside results from another group of occupants, a subset of the tenants in the Carmarthenshire study mentioned above. This subset comprised around 2,000 people who were interviewed directly about their health. This group was divided according to measures received and included a group whose homes had received external solid wall insulation plus ventilation, and others whose homes had received cavity wall insulation but no ventilation.

Those who received external wall insulation, which was always accompanied by

extractor fans, reported improved health – in fact external wall insulation plus ventilation was associated with the largest improvements of all the measures analysed in this subset, in terms of both respiratory and general health.

However, researchers found a worsening of reported health outcomes for occupants in homes which had been fitted with cavity insulation – which again, was not automatically accompanied by ventilation.

As the authors wrote: "The installation of the majority of individual housing measures (new windows and doors; boilers; kitchens; bathrooms; electrics; loft insulation; and insulation) were associated with improvements in several social and health outcomes... There were however a few exceptions. Most notably...in contrast to the expectations, the installation of cavity wall insulation was associated with poorer [i.e. worsened] mental and general health, and an increase in reported respiratory symptoms."

It is not known how the internal environment changed in these dwellings, though it might be reasonable to assume that, by analogy with the study described above, indoor humidity may have risen – and with it, possibly an increase in mould or dust mites.

Other research in Wales also suggests issues with cavity wall insulation. BRE Wales investigated instances of both cavity and solid wall installations where problems had arisen. Issues reported included damp and mould inside dwellings and sometimes damage to the building fabric.

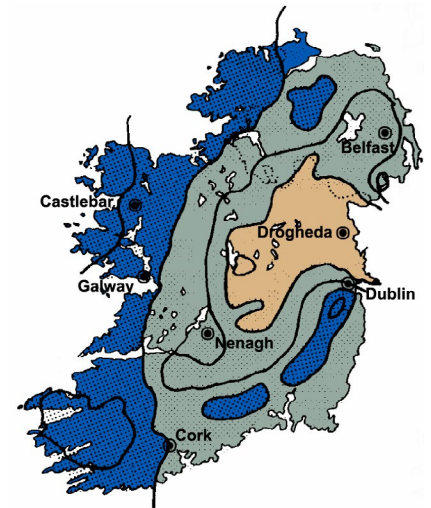
The BRE analysed the probable causes of the issues. They found that in many of the problematic cases, no assessment of the ventilation system had been made prior to the installation, that in some cases narrow cavities had been insulated, some houses were in high exposure areas. In some cases, cavity insulation had been installed in homes where the wall was in poor condition. This can allow the insulation to become waterlogged and cause damp issues inside.

Thus, there are two potential issues here – insulation installed in walls that are wet or at risk of becoming so, and lack of ventilation. Both increase the risk of damp and mould as well as other forms of indoor air pollution. Both however, come back to quality control in retrofit.

Designed ventilation

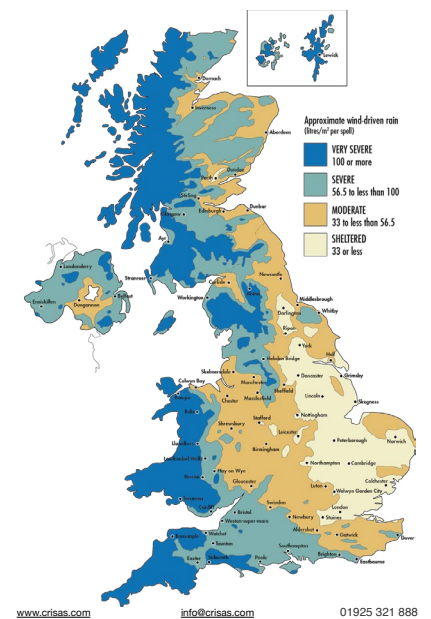
Proper ventilation is needed in any dwelling. It is required in order to remove the moisture created by day to day life – and to remove numerous other pollutants from indoor air. The Royal College of Physicians warned in 2016 that indoor air pollutants cause, at a minimum, thousands of deaths per year, and are associated with healthcare costs in the order of 'tens of millions of pounds'.

The ventilation in homes in the UK is seldom as good as it could be, and standard ventilation compromises occupant health. If retrofit of a house with inadequate or no ventilation reduces infiltration through the fabric – i.e. draughts – occupants will probably be warmer but alas, their air quality will be even worse, unless the ventilation is



UK Wind Driven Rain Map

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above Maps showing geographical exposure to wind-driven rain for Ireland & the UK. Some experts believe that areas with high levels of wind-driven rain may be unsuitable for cavity wall insulation.

Irish map: Joseph Little, adapted from BS 5262 coloured as per BR 262

UK map: BR 262

sorted out.

Ventilation should be part of every preliminary assessment of a home being considered for retrofit and remedying inadequate ventilation an absolute precondition for almost any additional intervention.

With retrofit, as with new build, the default ventilation option is still all too often intermittent extract fans in wet areas only. While the studies quoted show that this approach is better than nothing, there is too much evidence that it does not work adequately for it to be recommended, even in a relatively leaky building. Installing 'system one' ventila-

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tion like this is also a massive missed opportunity – both to benefit occupant health, and to cut fuel bills and reduce emissions.

System one ventilation does not leave any dwelling ‘2050 (or even 2030) ready’. The climate emergency means we need to insulate pretty much every dwelling and make them all a great deal more airtight, in order to meet our carbon goals. With an effective ventilation system installed from the start, it will be safe to improve the performance of the building fabric at any time.

Installation of continuous, centralised mechanical ventilation is the only way to prepare a dwelling for zero-carbon-compatible retrofit. This is implicitly recognised in the new PAS 2035 (see ‘The UK’s new retrofit standard’ boxout), which requires that a continuous ventilation system with demand control is installed if an energy retrofit reduces the air leakiness of the dwelling below 5 air changes per hour (at 50 Pascals of pressure) — or if it can’t be proved that it won’t do this.

A correctly designed and installed centralised mechanical extract (cMEV) or mechanical ventilation with heat recovery (MVHR) system will provide effective ventilation however airtight the dwelling – it does not rely on random leakage through the building to make up the air flow (which in practice, doesn’t always work anyway). Instead, the ventilation system supplies all the air needed.

Problems beyond ventilation

Failing to check and remedy ventilation is an established failing of the retrofit industry, but it isn’t the only one. Ventilation cannot remedy the issues caused by faulty wall insulation that lead to water penetration, and in turn to damp, mould and harm to occupant health. External wall insulation (EWI) has also been subject to water failures (see article on Preston insulation failures, in *Passive House Plus* issue 24) but cavity wall insulation (CWI) deserves at least as much attention in this regard.

Many areas in Wales, the west of England and Scotland, and much of Ireland in particular have climates that may not be suitable for retrofitting CWI (see map). Additionally, CWI should never be added where the outer leaf of a wall appears to be in bad condition (with cracked pointing or render, for example).

Ofgem monitoring of homes retrofitted under ECO (energy company obligation — the scheme requiring energy providers to upgrade homes) has repeatedly shown that CWI, along with other retrofit measures such as EWI, is installed inappropriately in a significant percentage of cases – for CWI this has been between 5 and 10% of sampled installations in recent years. In fact, overall technical failure rates rose over the duration of the second phase of ECO (see graph showing failure rates for all measures combined).

Yet Ofgem only refused energy company claims for carbon savings under ECO when an installer’s technical fail rate was over 10%. Ofgem commented that: “The average failure rates for CWI measures (5%) and non-high rise EWI measures (11%) were notably high”. Furthermore, 19% of the

THE UK’S NEW RETROFIT STANDARD

With the support of the government, the British Standards Institute has recently issued a new PAS (publicly accessible standard), PAS 2035, for domestic retrofit. This includes requirements on providing adequate ventilation when houses are being retrofitted for energy efficiency.

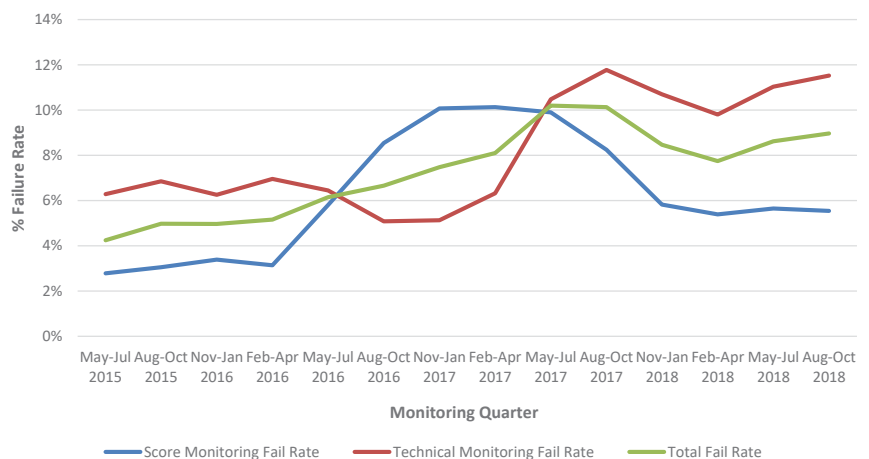
The new standard was developed in response to instances of retrofit failure, where installations were faulty and in some cases buildings were damaged, and householders failed to get proper redress. The new scheme sets out the qualifications and responsibilities of indi-

viduals involved in designing and delivering energy retrofit, and formal processes for managing risk.

The standard is expected to become a requirement in all UK government-mandated energy retrofit programmes (such as ECO) within a few years and may also be adopted as a requirement by other funding bodies such as banks.

Retrofit must meet the PAS standard if it is to be covered by the newly introduced “Quality Mark” guarantee, which offers consumer redress; the Quality Mark is also a government-backed scheme.

MONITORING FAILURE RATES OVER TIME



above Monitoring failure rates for ECO-funded retrofits in the UK between 2015 and 2018

installations (of all kinds, including cavity wall), which were supposed to have a guarantee, proved on investigation not to have a valid guarantee in place.

Clearly, insufficient action has been taken so far to address installation quality. The new BSI quality standard for retrofit, PAS 2035 (see below) is a fresh attempt to address this issue, though it is not expected to impact more than a handful of retrofits for a couple of years at least.

The health & retrofit agenda

Occupant health may finally be making its way onto the retrofit agenda. In its advice to the government on upgrading the energy performance of dwellings, the Committee on Climate Change, crucially, insists that the health of occupants must not be compromised by energy retrofit – but rather, should be enhanced. “Upgrades or repairs to homes should include increasing the uptake of: passive cooling measures (shading and ventilation); measures to reduce indoor moisture [and] improved air quality,” it says.

“An integrated approach to design, build and retrofit is needed. Regulations around

ventilation must evolve to keep pace with improvements in the energy efficiency of buildings, and there is a need for a more coordinated approach to the requirements for energy and ventilation in buildings. Rather than piecemeal incremental change, long-term investments that treat homes as a system are needed.”

The evidence shows that this position is right, and when carried out appropriately without neglecting ventilation, retrofit can indeed improve occupant health.

Done well, an energy retrofit can be transformative. As one grateful recipient explained: “The new heating was installed when my brother had bowel cancer. It got to a point where even the slightest chill would be a detriment to him. It gave us more control and was more efficient. It helped keep him from shivering when trying to keep warm, it helped him recover. It couldn’t have come at a better time in his life.”

There is no reason why anyone who could benefit from a warmer, healthier home should be suffering in cold, damp unhealthy accommodation. We know how to make it better.

Marketplace News

Photo: Mark Siddall from LEAP, lovingly engineered architectural practice.



Barn retrofit achieves 0.18 ACH with bi-fold doors

A deep retrofit project in Lancaster has achieved possibly the best ever airtightness result in the UK for a retrofit project. Designed by leading passive house architect Mark Siddall, Shepherd's Barn is a super insulated, low energy barn conversion which incorporates high standards of airtightness and an MVHR system.

Due to the wide span of this particular barn, a cellulose insulated timber frame structure has been inserted inside its original walls. To address moisture risks, cavities are well ventilated and microporous additives have been added to the lime-based mortar where walls have been re-pointed or replaced.

The clients were keen to install sliding folding doors, and so Lacuna bi-fold doors were specified on the project, supplied and installed by Green Building Store. Bi-fold doors are often regarded as a difficult element of the building element to make airtight, but the Shepherd's Barn retrofit still went on to achieve a superb airtightness result of 0.18 air changes per hour, well inside even the new build passive house standard of 0.6 air changes per hour, and the best airtightness result for a UK retrofit project this magazine has heard of to date.

Speaking to Passive House Plus, Morten Wendt of Lacuna UK & Ireland, explained that its doors have a triple-seal between the door elements, and a double seal around the edges. They can reach an overall U-value as low as 0.85 W/m²K, and they achieve class four airtightness (EN 12207).

"At Lacuna we focus exclusively on bi-fold doors in order to make them perfect. That means all research goes into this single product," Wendt said.

"The aim of our Danish design is that the door should be looked upon as a piece of furniture: narrow frames, painted in complete smooth high or low gloss, complemented with marine-grade handles and hinges. We supply a durable, dimensionally stable door with unrivalled U-values and airtightness. It is very easy to install and doesn't require continuous adjustment visits."

Lacuna's frames are constructed from heat-treated timber, which the company says gives them a durability equal to teak. They should not require repainting for between 25 and 50 years in normal conditions, and they offer the slimmest profile available of any timber folding door, according to the company. All ironmongery is in Danish designed marine grade materials.

For more information on Lacuna bi-fold doors see www.lacuna-bifold.co.uk. ■

(above) Lacuna bi-fold doors at the Shepherd's Barn retrofit.

Channel Islands gets its first passive house



(above) Installation of the MVHR system at the first passive house in the Channel Islands.

A passive house new build has commenced in Guernsey and, when certified, it will be the first project in the Channel Islands built to the standard. Located on the west coast of the island, Le Catillon is a single-storey dwelling being constructed for an architect and his wife as their low energy holiday home.

The clients worked closely with Accredited Passivhaus Design to achieve their designed level of design and performance, with Warm Low Energy Building Practice appointed as the passive house certifier.

Keen to harness local expertise wherever possible, Guernsey-based contractor RG Falla Ltd was appointed by tender, and locally sourced materials are being used throughout, including a granite outer skin.

The specialist mechanical ventilation with heat recovery (MVHR) project contractor is Built Environment Technology Ltd, who were appointed after a recommendation from Accredited Passivhaus Design, having previously collaborated on passive house projects on the mainland. Although a Kent-based company, Built Environment has clients from northern Scotland to the south of France and is experienced in managing projects from a distance.

The Zehnder ComfoAir Q350 MVHR Unit was specified, complete with a LAN C Gateway and full app control, with ductwork supplied by Lindab comprising galvanised spiral around the unit, with InDomo Ø90 radial ducts to receiving rooms. Intake and exhaust ducts are insulated with 50 mm Armaflex, with the short, exposed ducts and cowls above roof level in stainless steel – an essential anti-corrosion measure due to the very close proximity to the ocean.

When asked about the challenges of meeting the stringent requirements of the passive house from such a distance, senior projects manager at Built Environment, Richard Porteous, said: "It's always a pleasure to work with the passive house community, where performance is key and detail is critical. Both the designer and the client at Le Catillon have set very high standards and the planning and preparation process has been meticulous. As a result, every last detail had been agreed before attending site and we are fortunate to have an excellent projects team and extremely capable site personnel. First fix ductwork is now complete, and we look forward to completion and commissioning." ■

Blowerproof gets passive house cert



(above) Blowerproof applied to the inner face of blockwork at a wall chase before dotting and dabbing plasterboard, in architect Mel Reynolds' project in Sandycove, Co. Dublin. The project is aiming for the passive house plus standard.

Blowerproof liquid airtight membrane has achieved Class A passive house component certification for both its liquid and fibre-reinforced brush applications.

Blowerproof's paint and spray-on liquid airtightness products have become increasingly popular in the low energy building and retrofit markets in recent years, with the product being specified on an increasing number of passive house projects, and becoming highly regarded for its ability to air-seal tricky details and junctions.

"I am delighted we have obtained this certification," said Herman Van Damme of Blowerproof manufacturer Hevadex. "The rigorous testing it's put through by the [Passive House] Institute really proves the superior performance of Blowerproof for use in passive buildings and is recognised by designers as a certification they can rely on. It helps make everyone more comfortable about specifying and using Blowerproof."

Blowerproof have also announced a significant update to their BBA certificate. The update means that Blowerproof liquid version is now certified for use as a radon barrier, and for dot-and-dab applications behind internal plasterboard. It also now has a Class C-s1 fire rating.

"Blowerproof have moved to strengthen their position in the market by improving their certification and accreditation in light of increasing specification and demand in the market," Will Kirkman of Blowerproof UK told Passive House Plus. "We are seeing the product being specified more and more given the push towards net zero carbon buildings and with changes on the way to Part L and F of the building regulations."

The new certificates can be downloaded from www.blowerproof.co.uk. ■

Moisture monitoring key as energy standards rise



(above) Tramex's moisture mapping app, used in conjunction here with a non-destructive Tramex moisture meter.

Tramex, the manufacturer of moisture meters for the building design and construction industries, has emphasised the critical importance of testing and monitoring moisture conditions within buildings as airtightness and insulation standards continue to increase.

Improvements to building regulations in recent years mean that homes and offices are becoming more and more airtight, and while mechanical ventilation is being increasingly specified as the best way to remove humidity, natural ventilation is still popular. Because natural ventilation is not generally as effective at removing humidity as mechanical ventilation, it is these homes that may be at most risk of dampness and mould, both surface-level and interstitial condensation within the building fabric.

And while moisture issues are always a concern in retrofit, ambitious new build standards mean they are now an increasingly an issue on new projects too. Combine that with the damp UK & Irish climates and the amount of moisture typically contained in building fabric during construction, and Passive House Plus has heard reports of mould appearing on some new build projects even when still on site.

Wicklow-based Tramex have been manufacturing their moisture meters to their core market in the US for many years, but are now seeing increased potential for their use in the UK and Ireland as buildings standards rise.

The company supplies a range of data loggers, moisture meters and probes. These range from simple sensors that log internal

humidity, to tools for 'moisture mapping' of building assemblies which can produce the moisture equivalent of thermal images, and small non-destructive probes which can be inserted into walls that be used to test moisture conditions.

The company's data loggers are bluetooth enabled and provide five-minute interval readings of a range of moisture, humidity and temperature indicators. It can also provide interstitial data when connected to probes.

Speaking to Passive House Plus, Andrew Rynhart of Tramex also stressed that solutions are available for building assemblies found to contain excessive levels of moisture. "We aren't just here to diagnose problems but can advise on solutions as well. For example, there are now injection tools available for injecting dry air into walls to dry them out."

John Morehead of Wain Morehead Architects – a firm known for their technical expertise in building performance – recently discovered Tramex via Passive House Plus and purchased equipment including the ME5 non-destructive moisture meter for instant moisture measurement and evaluation.

"With the Tramex ME5," said Morehead, "we finally have an instrument available that measures moisture in a non-invasive manner at variable depths that enables the operator with the app to instantly visualise and record and understand what may be happening." Morehead described the meter as "indispensable for conservation or building defect/expert witness work with industry standard calibration." ■

Good design integral for latest MBC passive house



For new self-builders Andrew and Lynne Webster, spending extra time and money on the design stage of their new passive-grade timber frame house proved to be one of the best decisions they could have made.

Chartered architectural technician Tony Holt, of Tony Holt Design, worked with the couple through a concept design phase, before gradually fine-tuning it into a 'ready for planning' drawing.

"At this point," Andrew commented, "many self-builders opt to head straight into the build phase, but we recognised the value that would be brought by retaining Tony Holt to bottom out the detailed design, despite the additional cost."

"Having watched endless episodes of Grand Designs, one thing screamed out at us – problems seem to happen mainly for people who hadn't committed enough resources to planning their project fully. Detailed design work tends to force you into

looking more closely at the tiniest of details."

Andrew and Lynne considered various build systems, but ultimately opted for timber frame. "I knew I would be managing the build myself," explained Andrew, "yet I was acutely aware that I had a full-time job and my time on site would be limited. Building with timber frame gave me two key advantages. Firstly, I could devote whatever time was needed in the weeks and months preceding the build to ensure that everything had been considered and accounted for – I knew to the millimetre what I was going to get! Secondly, I wanted to limit the 'wet trades' on site."

The couple chose MBC Timber Frame in Gloucester, they say, mainly because their reputation was good both in terms of the quality of their frames and their professionalism on-site.

The couple specified MBC's passive standard slab with underfloor heating included, as well as their twin wall passive

standard frame. Detailed up front planning also helped to ensure smooth installation of the building services and window installation.

"The finished house speaks for itself – we provided a high level of detail to MBC Timber Frame and in return things went pretty smoothly when we came to the all-important erection of the timber frame phase of the project," Andrew said.

"Even on the coldest of mornings, the triple glazing does very well to retain heat. We did account for adding small radiators in the bedrooms if we ever felt the need, however, we're now entering our third winter in the house and we still don't have them."

No doubt this is due in no small part to the excellent air test results – a measured air permeability of just 0.21 air changes per hour.

A longer version of this case study is available at www.mbc timber frame.co.uk. ■

LAMILUX LIGHTS UP NEW PASSIVE BUSINESS CENTRE

An impressive assembly of passive-certified skylights is helping to ensure that the occupants of a unique new eco business centre in Oxfordshire can work in an indoor environment full of natural light.

Designed by leading passive house architects Architype, Bicester Eco Business Centre is a one-of-a-kind hub providing 125 modern workspaces whilst supporting start-ups and small businesses. It is part of the new North West Bicester eco-town, a development of over 6,000 sustainable homes.

The landmark business centre, which opened its doors in October, is the first non-residential building in the UK to achieve the passive house 'plus' standard. The plus standard rewards passive

house projects that also generate a certain amount of on-site renewable energy.

LAMILUX supplied and installed a total of 25 glass skylights, smoke vents and access hatches for the building. These were comprised of 18 passive house certified (pH advanced component) Skylight FE units with an overall U-value of 0.84; six Glass Skylight FE3° smoke vents with a glazing U-value of 0.6 W/m²K; and one Skylight FE0° access hatch.

"The skylights not only bring daylight and fresh air into the building for a sense of wellbeing, but also provide smoke and heat exhaust ventilation for the safety of the tenants in the event of a fire," Natalie Goodridge of LAMILUX UK told Passive House Plus. ■



(above) LAMILUX skylights at the Bicester Eco Business Centre.

Passive Purple used to seal Beattie Passive Enerphit



(above) The external airtight layer and void-forming brackets in place at Beattie Passive's Enerphit project for Great Yarmouth Borough Council; and (right) a rendering of the finished scheme.

The innovative Passive Purple airtightness paint from Intelligent Membranes has been used to form an external airtight layer on an Enerphit project in Norfolk. The BEIS-funded deep retrofit to a block of six flats for Great Yarmouth Borough Council is being delivered by passive house specialists Beattie Passive.

According to Nathan Beattie of Beattie Passive, the flats are being improved from SAP EPC ratings of D and C and retrofitting to the Enerphit standard – using a new system which not only enhances the performance but addresses fire prevention in the wake of Grenfell, to ensure that the cladding is fire retardant.

"We've used Passive Purple as an airtightness membrane – sprayed to the outer face of the original walls," said Beattie. "Our

brackets are then fitted, which creates a void for the Ecobead insulation." The walls are finished with Magply board, a Frametite weather membrane, battens and a Steni pre-finished render board with a textured finish. The retrofit will also include new Munster Joinery triple glazed windows and a Catnic steel roof.

The project, which started in September, is due to finish by the beginning of February. With airtightness tests pending, Beattie is confident that the decision to work with Intelligent Membranes to spray the Passive Purple airtight layer on the outside of the building – therefore avoiding tricky junctions at party walls and intermediate floors – will be vindicated with a test result below the Enerphit target of 1.0 ACH @ 50 Pa. "They're a great team that have hopefully made the building airtight in a

couple of days. I'm looking forward to the airtightness test. I believe it'll do well."

Meanwhile, Intelligent Membranes have partnered with the Woodland Trust in a long-term tree planting initiative. "Every time you place an order, we'll plant a tree," said Intelligent Membranes CEO Adam White. "Our aim is to plant 5,000 trees next year on our land in Croydon." The scheme will involve planting indigenous trees, including oaks and a broad range of species. "We'll even be able to tell you which specific tree was planted for you," said White. "My aim is to make sure before I retire we help plant a million trees, through also encouraging other companies to sign up with the Woodland Trust – and we'll offer 5% discounts on all our goods to any companies who prove to us that they've signed up too." ■

Ultra Quiet Ecodan awarded Renewable Energy Technology of the Year

Mitsubishi Electric's Ultra Quiet Ecodan air source heat pump range has been handed the Renewable Energy Technology of the Year award at the Energy Awards 2019, which recognises and rewards excellent and intelligent energy use in the industry.

Over 500 energy industry professionals gathered at the ceremony in London on 21 November, to celebrate the achievements of the best in the industry across twenty categories, which recognised products, projects and employees. The entries were judged by a panel of 15 industry experts from organisations including ENGIE, Ofgem and Carbon Trust, who voted Mitsubishi Electric's Ultra Quiet Ecodan as the renewable energy technology product of the year.

"We are delighted to receive another prestigious accolade for the Ultra Quiet Ecodan. It truly is testament to the 10 years our team has spent refining Ecodan into a super quiet heat

pump that specifically addresses the increasingly important issues of noise and energy efficiency in our built environment," explains Max Halliwell, communications manager for renewable heating at Mitsubishi Electric.

The Ultra Quiet Ecodan is the latest market-leading air source heat pump from Mitsubishi Electric, and provides reliable, renewable heating and hot water production for a wide range of installations. As heat pumps are adopted in more homes to help meet the government's target of one million installations a year by 2030, noise will become an increasingly important factor. Additionally, with a sound pressure level of just 45 dB(A), the Ultra Quiet Ecodan is exceptionally quiet, meeting Permitted Development requirements.

The system is also A++ ErP rated, meaning it meets the highest standard outlined by the energy related products directive associated with reducing energy usage to

meet EU targets.

The units are available in 8.5kW and 11.2kW sizes, with market-leading sound levels that are three times quieter than previous models. Further details can be found on the dedicated website: www.ultraquietecodan.co.uk. ■



(above) Pictured at the Energy Awards 2019 are (l-r) the Sustainable Energy Association's Ilias Vazaio; Mitsubishi Electric's communications manager for renewable heating, Max Halliwell; and Energy Awards 2019 host, comedian Miles Jupp.



In praise of impermanence

We hear a lot about the importance of designing our buildings to have a long lifespan, but might there come a time when it actually makes more sense to design buildings to have relatively short lives — and to be easily taken apart and re-purposed in response to a changing climate and society? *Toby Cambray* ponders the idea of impermanence in construction.

It's usually tacitly accepted that we should make our buildings last as long as possible. This makes some sense from an economic perspective; the longer an asset can be useful, the more value can be extracted from the investment. As time goes on, buildings inevitably become less fit for purpose, and they are continually adapted to cater for the needs and preferences of new occupants.

If the Victorians tried to predict our early 21st century needs and preferences when they were building, they were not successful, at least when it comes to comfort and energy. Is it hubris or arrogance that makes us think that we can design for socio-political, economic,

Homeowners are more likely to invest in changing the latter than the former. What we're really talking about here is locking in bad decisions or at least, contemporaneous ones.

So, perhaps we should be designing buildings for a shorter life span, rather than a longer one, simply to avoid locking decisions in; even those we consider to be good or correct now may prove misguided in 50 years. It should also be acknowledged that 'designing' for a particular lifespan is a misnomer, like 'designing' for a finite airtightness, unless you're particularly cynical.

Another very important aspect, particularly given the UN's 12 years (make that

means the house will only last as long as Ben's need for this specific home. Happily, the fabric of the building treads very lightly on the earth, being a hyper-local timber frame and straw bale construction.

This reversal of attitude to longevity would mean that the way we build can be continually adapted in a changing climate, social and economic conditions, and bad ideas need not have their repercussions resonate for centuries. As I write this in 2019, design for impermanence is not a good idea, at least not for mainstream deployment. In the absence of widespread effective approaches to minimise embodied carbon and to recover materials and components at the end of life, the carbon and resource depletion implications of this idea are completely unsustainable. But if these pre-conditions are fulfilled, it could become a useful concept in creating, and continually re-creating, a sustainable built environment. ■

“ Perhaps we should be designing buildings for a shorter life span.

environmental constraints as they will be 100 years from now? Our more developed science certainly gives us a better idea of what the future climate will be like than our forebears had, but the variation in possible outcomes is considerable.

Deep energy retrofit is hard, especially, I would argue, in less old buildings. There are good reasons to persevere with our old stock – heritage value, the larger carbon burp of re-build, economics. But I am not alone in arguing that it will be even harder to retrofit the type of houses being built to current UK regulations and standard practices in their thousands across the country today. Their moisture-blocking design principles often introduce tricky factors, and their arguably low quality and moderate levels of insulation undermine the economic case.

In the UK and Ireland, we can expect the climate to get warmer (particularly the summer) and wetter (particularly the winter) over the next 100 years but designing with this in mind is not as common as one might hope. A less technical example is the change in fashion from separated cooking, living and eating spaces typical of buildings more than about 50 years old, to the 21st century trend for more open plan houses.

11 and counting) to stay within 1.5C of warming, is embodied carbon, and building lifespan is an essential factor in calculating embodied carbon. I am emphatically not suggesting that it's a good idea to send to landfill or incinerate everything built to date. What I would say is that embodied carbon is rising rapidly up the agenda, as is design for disassembly, and if we as an industry can get good at these, design for impermanence may, or may not emerge as a useful concept.

There are precedents for this approach, most notably in Japan where house values (as distinct from land values) depreciate such that they are worthless after about 30 years. A specific set of cultural values and economic conditions drive this; land is expensive, but the buildings on them are less valued, in part because, in the architect Alastair Townsend's words, “Japan fetishizes newness”ⁱ.

Ben Law's famous Woodland house is an example closer to home. The planning authority hedged against this house setting a precedent for building in a sensitive area of greenbelt by applying a condition that the house cannot be sold and must be removed if Ben ceases to manage the woodland. This

ⁱ www.archdaily.com/450212/why-japan-is-crazy-about-housing

Toby Cambray is a founding director at Greengauge and leads the building physics team. He is an engineer intrigued by how buildings work and how they fail, and uses a variety of methods to understand these processes.

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“Green Building Store were brilliant members of the MVHR team on the Goldsmith Street project and it was good to tap into their superb technical know-how. They delivered the systems that we designed efficiently and reliably and also came to site to commission every single one of the MVHR units at the project.”

Sally Godber *WARM*

Toby Cambray *Greengauge*

M&E and Environmental Services
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image: The Stirling Prize winning
GOLDSMITH STREET PASSIVHAUS
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Green Building Store supplied and
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