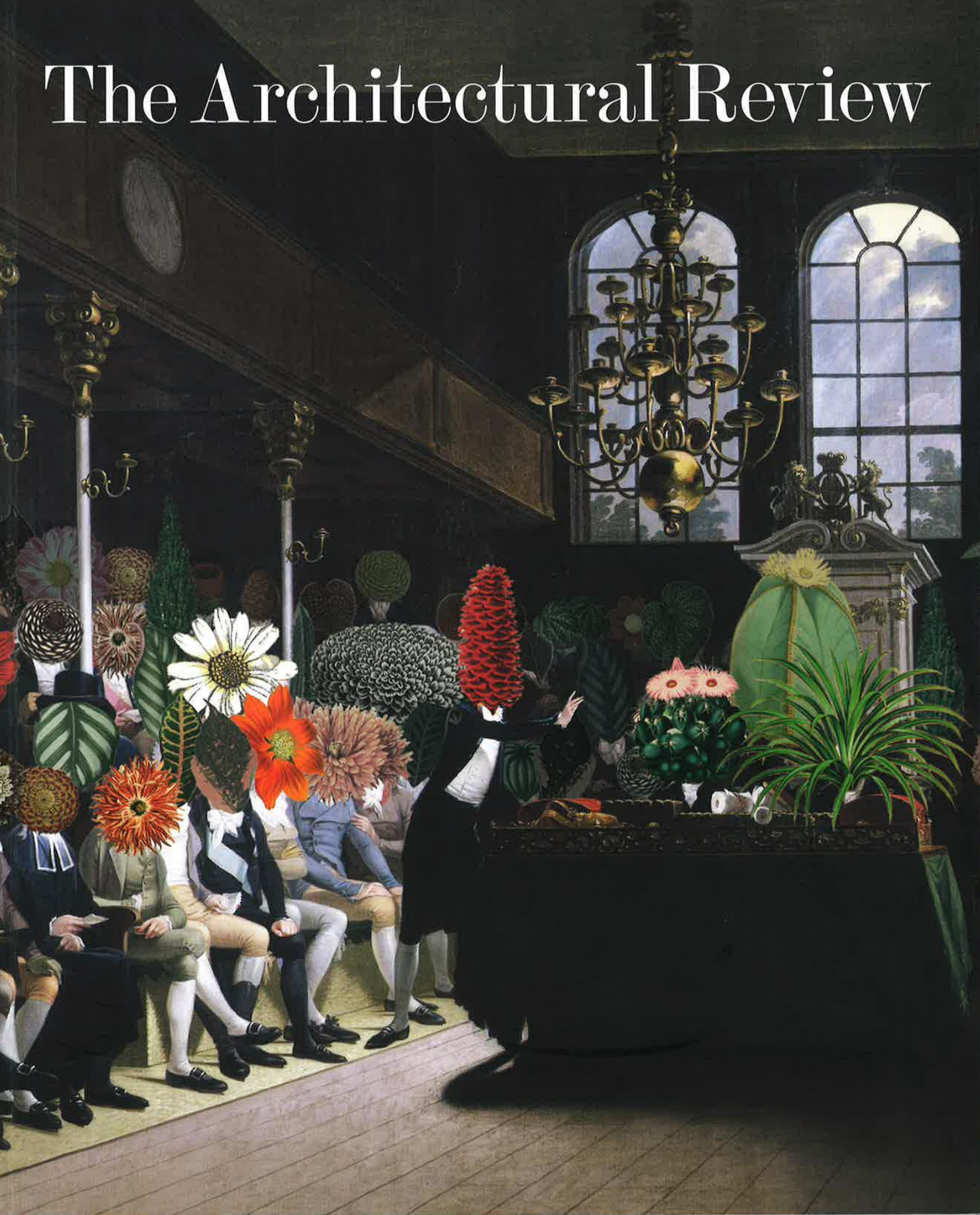
The Architectural Review



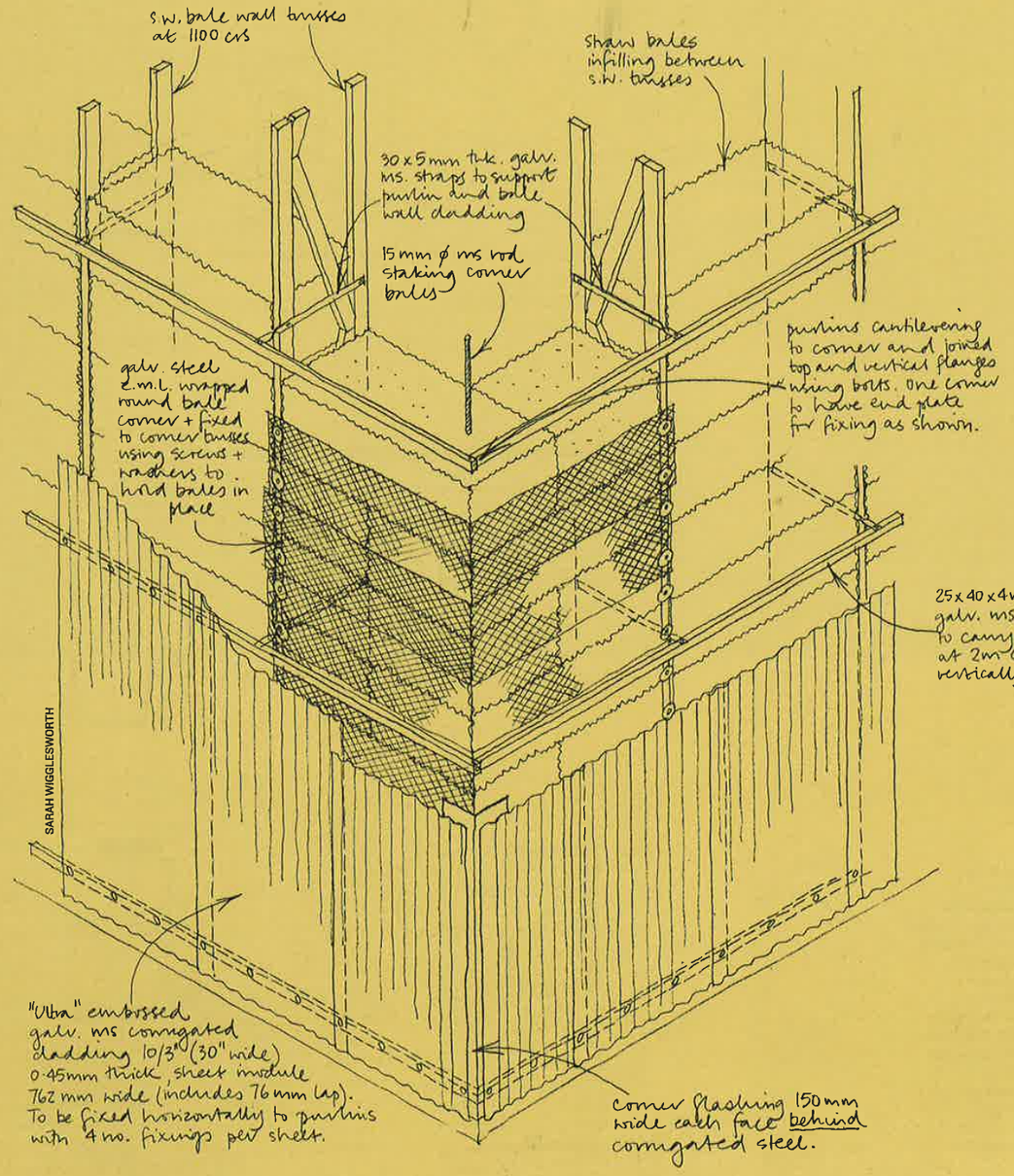
Revisit
Straw Bale House

The retrofit of Sarah Wigglesworth and Jeremy Till's London home demonstrates a light-handed, evolving approach to building with biofibre, writes *Martha Dillon*

SARAH WIGGLESWORTH & JEREMY TILL

PAUL SMOOTHY

Completed in 2001, Sarah Wigglesworth and Jeremy Till's home on 9/10 Stock Orchard Street in London (left) was conceived as a 'plaything' through which the architects could test salvaged and plant-based building materials. The straw bales used in some walls (above and opposite) soon gave it the moniker 'Straw Bale House'. Speaking in 1999 on the first season of *Grand Designs* (top left), Wigglesworth noted that straw bales were 'a vehicle for invention'



SARAH WIGGLESWORTH

1 entrance to house
2 bedroom
3 storage
4 retrofitted kitchenette
5 study / bedroom
6 bathroom
7 entrance to studio
8 study
9 terrace
10 kitchen
11 larder
12 living room
13 stairs to library tower
14 dining room / conference room
15 studio

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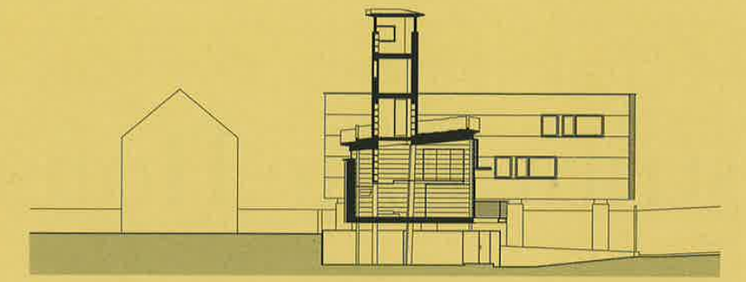

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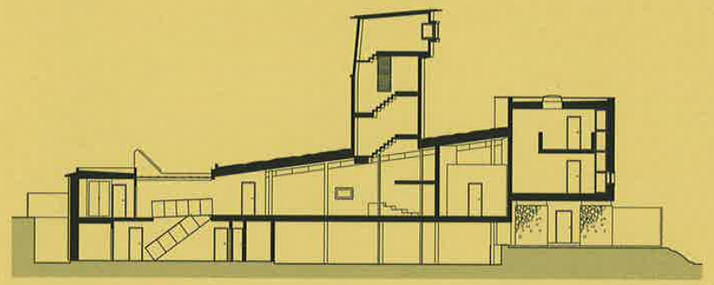

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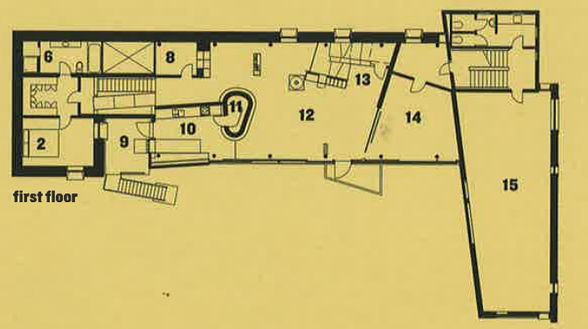
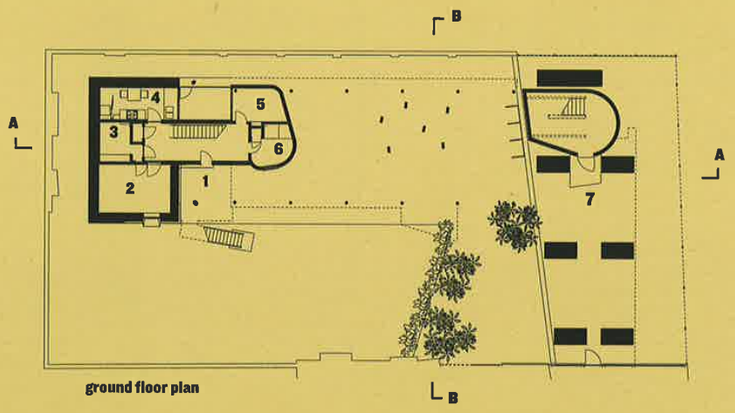


first floor



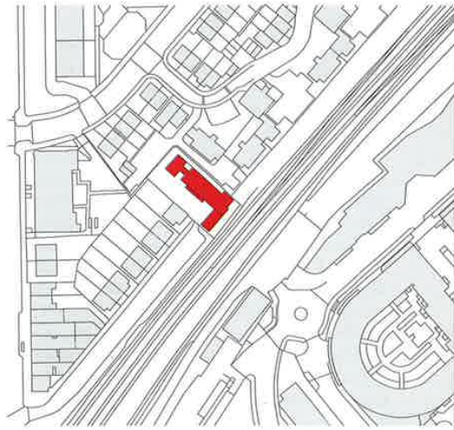
ground floor plan

In the lead-up to the building's 20-year anniversary, the couple commissioned an in-depth energy-efficiency analysis of the building, which subsequently led to a retrofit by Sarah Wigglesworth Architects (SWA) in 2019. The straw bale elements, covered by a ventilated steel rainscreen (opposite) were found to be performing well, and did not need replacing

LUKE HAYES

Number 9/10 Stock Orchard Street, colloquially known as the 'Straw Bale House', is 'unusually transparent about its design procedures', according to Adrian Forty, writing in the 2011 compilation about the building, *Around & About Stock Orchard Street*. 'In its shagginess, its hairiness … [it acknowledges] at least some of the unresolved business of architecture.' Today, the building is approaching its 25-year anniversary, and its designers Sarah Wigglesworth and Jeremy Till – who are also its residents – continue to openly embrace its unresolvedness; a few years ago, they retrofitted their famous green building and published all the intimate details online.

It is hard to succinctly introduce a structure which has been proudly filled with 'too many ideas', according to Till, but here is a version: 9/10 Stock Orchard Street is a house and an office for Wigglesworth's eponymous architecture firm. The two hinge around a room used for conferences and dining, part of Wigglesworth's treatment of what she calls her 'two dual roles – homeowner and boss'. It is self-built: managed, run and partly constructed by Till and Wigglesworth themselves. And it was, at inception in the late '90s, 'an attempt to contribute a new sensibility' to ecological architecture. Having formerly seen sustainability as a 'straitjacket on individual expression', as Wigglesworth writes in *Around & About Stock Orchard Street*, in the late 1980s she became aware of 'a distinct appearance that was both



Part of SWA's retrofit of 9/10 Stock Orchard Street was a 'future-proofing' of the house, which included converting ground-floor spaces into a small private suite for a live-in carer, should one be required in the future. This is accessed through the main entrance to the house (right)

The carer's suite includes a bedroom (below left and below right) and kitchenette. This, as well as other elements of the retrofit, were informed by Designing for Wellbeing in Environments for Later Life (DWELL), a research project led by Wigglesworth at the University of Sheffield from 2013 to 2016. The stairs (right) lead to the main living space on the first floor

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'Notably, the famous straw bales and their novel rainscreen protection remain in good condition'

articulated and functional ... the possibilities for green building began to emerge with greater clarity'.

The resulting contribution is striking. Though propped on a partial concrete-steel frame and poured foundations, the bulk of 9/10 Stock Orchard Street is a jigsaw of bio-based, reused and self-made components. Around the house, the famous 'hairy' walls comprise stacks of 550 Cotswold barley straw bales, inside a slim timber frame and ventilated steel rainscreen – this allows moisture to escape, protecting the bales from rot. Some 1,700 sandbags form the wall adjacent to the nearby railway line, cushioning the sound of the trains. The bags contain lime and cement mixed with the sand, meaning that they hardened once stacked and sprayed with water. The polypropylene covers have since eroded – by design – under the sunlight, leaving a wall of chubby bricks. Underneath, piles of recycled concrete gabions lift this part of the building to the sunlit street level of its Georgian neighbours. Wigglesworth and Till have described their work as a 'test bed' for alternative materials, but today it also feels like a test of the role of architects in a circular economy: as researchers, gatherers and shapers of materials.

The recent retrofit, which took place in 2019, did not require any major changes or upgrades to the building's core materials. Notably, the famous straw bales and their novel rainscreen protection remain in good condition. This affirms their effectiveness in more complex architectural forms than a simple small dwelling – 9/10 Stock Orchard Street is, as Wigglesworth and Till acknowledge, an unusually large private home for two people. The bales are 'as golden as the day they were first laid', observed journalist Nell Card in 2020. 'Unlike the polycarbonate sheets [which provide a window onto the bales], which are cracked and taped together in parts.'

Today it is also possible to be more precise about the ecological impact of straw. Calculations from 2021 by Natural England show that English arable land does not usually store a significant amount of carbon, compared with woodland or bogs, since the crops are farmed off (and then typically used as animal feed, thus not permanently trapping greenhouse gases). The only real carbon storage it provides is in the soil, and poor agricultural practices can enable soil erosion and a net loss of carbon every year. In the case of straw, which are the stalks of cereal grasses such as wheat, oats, rye, barley and buckwheat, soil erosion occurs if fields are left bare after a harvest, leaving them susceptible to degradation between growing seasons, and less able to absorb and hold water and nutrients. Carbon-intensive and ecologically damaging fertiliser use is also common in the growing of straw crops. According to the International Fertilizer Association, every hectare of wheat and other cereals in the UK is fed around 180–250kg of inorganic fertiliser, half that of roots and tubers, but more than crops such as maize and sugar. Like all crops, straw is usually harvested, baled and transported using diesel-powered agricultural machinery and vehicles.

But straw remains promising as an ecological building material because regenerative agricultural methods are possible. As sustainable sourcing specialist Ele Gower explains, soil erosion can be avoided by growing multiple crops at one time ('undersowing') to trap moisture and nutrients, using cover crops when a field is not in use, and staggering crop cycles to avoid fallow periods. The Union of Concerned Scientists estimates that growing the oats for a year's supply of Honey Nut Cheerios (180,000 acres) from US farms adopting cover crops and more diverse crop rotations could prevent the loss of tens of thousands of tons of soil per year, reduce nitrogen run-off and avoid freshwater pollution, among other benefits. The electrification of vehicles and machinery is also approaching – though hampered, says Gower, by an attractive rebated duty rate for agricultural diesel. Where new buildings are justifiably required, materials such as straw allow for construction with no permanent impact on the planet at all. By contrast, 60 per cent of emissions in cement production comes from the chemical process of calcination itself, and can never be fully avoided.

Wigglesworth and Till decided to retrofit 9/10 Stock Orchard Street because they were aware, says Till, 'the environmental credentials were not what they should be'. This largely related to airtightness, which they did not consider in depth in the original design, it being less well

Number 9/10 Stock Orchard Street is, by Till and Wigglesworth's own admission, a large house for two people. Energy deficiencies within the house, identified by the energy consultancy Enhabit as part of their review, were primarily to do with airtightness. Improvements made to skylights and floor-wall junctions helped make the house, with its large open volumes (right, below and opposite top) more energy efficient and closer to Passivhaus best practice. Eight per cent was knocked off the couple's energy bill as a result. The retrofit is part of an ongoing approach of adaptation and tweaking. As Wigglesworth (above) told the *Observer* in 2020, 'Your home should be treated as if it were a part of your body. It is a kind of bigger expression of yourself, and you need to look after it.' This evolving approach is part of the wider ethos of SWA, whose offices connect to Wigglesworth and Till's home through a conference and dining room (opposite bottom)

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understood as a driver of poor performance. Design consultancy Enhabit reviewed eight years of energy consumption data from the building to map its occupancy patterns. They installed probes to monitor U-values, a measure of the effectiveness of the insulation, carried out thermal imaging to spot where heat losses were concentrated, and did a full airtightness test to identify draughts and leaking air. This set of tests was coupled with a detailed Passivhaus model of the building.

The results saw Wigglesworth and Till 'picking apart a lot of the building and putting it back together in a more energy-efficient way', they wrote in *RIBA Journal* last year. They added insulation to the south-west-facing glass wall in the living space, undercroft and lower floors of the tower. They used airtightness tapes at floor-wall junctions and around incoming services, and swapped out leaky components, doors and windows; replacing just one large rooflight knocked eight per cent off their energy bills. Solar shading was added to the south-west facade to reduce glare and overheating.

These updates were concentrated around the steel components, mechanical openings and majority-glass facades. The heat loss mapping and U-value tests indicated that the straw bales are insulating the property relatively well, transferring heat at a rate of 0.22W/m²/K. This is a fifth of the rate of heat loss of a solid brick wall, though a little higher than the best practice Passivhaus recommendation for new buildings. Wigglesworth notes that performance

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A bulbous volume houses a larder (right), which helps separate the kitchen (above) from the living areas. A table plank 'breaks out' of the kitchen wall, protruding into a small terrace looking over the garden (far right). The house, which sits snugly up against train tracks (opposite), is located on the site of a former forge

would have been better had the original external air cavity been built slimmer.

The changes made to 9/10 Stock Orchard Street have reduced its annual CO_2 emissions by around two thirds, and cut air leakage nearly in half. Its space-heating demand, a typical indicator of overall environmental performance, was reduced from 190 to 72kWh/m². This is less than half the UK average, despite the large volume of the building, which means it will inherently require more energy to heat. This meets the 60 per cent reductions in space-heating demand that is the LETI recommendation for best practice retrofits, though LETI specifies a slightly lower absolute target of 50kWh/m².

Though the retrofit results are a reminder that any type of building can and should be retrofitted, much more interesting is the fact that Wigglesworth and Till had always planned to modify the building. They are believers that structures should be built to be maintained, that they should 'never stay still'. They describe buildings as being like organisms, or bodies, that must be maintained and 'tweaked'. They have long pushed back on construction 'that has no maintenance or where things don't need to be replaced for a very long time ... a kind of modernist mindset where buildings are this sort of thing you can just erase and start all over again from scratch'. The pair still live in their straw, recycled, ever-changing house, and their retrofit included adaptations for later life so that they can continue to do so.

This confounds the prevailing view of what it means for a building to be long-lasting. Some – namely manufacturers and the supposedly independent reports they fund – argue that the theoretically long lifespan of concrete and steel somehow justifies the upfront carbon required to create them, playing into the vague idea that 'durable' means 'permanent'. Decisions to raze and rebuild homes are often justified on the basis that they have fallen into disrepair – with little or no evidence that the new buildings, made from the same materials, will be better looked after. In contrast, 9/10 Stock Orchard Street suggests that 'durable' might relate less to fixed forms and an irreversible impact on the planet than to a long-lasting, light-touch place that evolves and changes.

The combination of a more holistic vision of durability with bio-based materials seen at 9/10 Stock Orchard Street has perhaps been overlooked, thanks to an enduring mythology that bio-based materials are fragile. Today, it is a common complaint in the industry that timber buildings are hard to insure, jeopardise mortgages, and get nixed by planning departments' fire safety specialists. Wigglesworth and Till report troubles, still, in reinsuring and valuing 9/10 Stock Orchard Street (one assessor told them to 'tidy up' the facades and install a carport), and today find it harder than ever to secure timber insurance at a reasonable cost, or to specify combustible materials for projects over three storeys.

In reality, straw bales are so airtight as to be essentially non-flammable (though straw flakes on site are dangerous, just as construction dust is), and there are detailed Fire Safety standards and requirements in place for bio-based construction, just as there are for other materials. Many straw homes that exist today are well over a hundred years old – considerably longer than the 25 to 30 years that many commercial buildings now survive in the UK. Material safety is critically important, but so too is constructive engagement with planetary-safe materials by regulators and insurers. It is characteristic of the intransigence of the UK's built environment sector that a bio-based building might be more difficult to build and insure today, some two decades further into the sustainable transition, than it was in 2000.

This project is not a perfectly ecological building. But it is a huge shame that the sector of the early 2000s – planners, insurers and designers alike – did not take more from its anti-technocratic and creative approach to 'green design', particularly in relation to material usage. Where new buildings cannot be avoided, sustainably produced bio-based materials really are one of the few options for structures that avoid a permanent impact on the planet. Hopefully today we might learn more quickly from the 2019 upgrade, which not only illustrates that retrofits are workable in the most varied and hairy of architectural forms, but that the so-called 'war effort' to complete one-off retrofits is short-sighted. All our homes should be as lovable, humane and liveable as 9/10 Stock Orchard Street, and certainly they should be cared for as deeply, as regularly and for as long.

'It might be more difficult to build and insure a bio-based building today than it was in 2000'