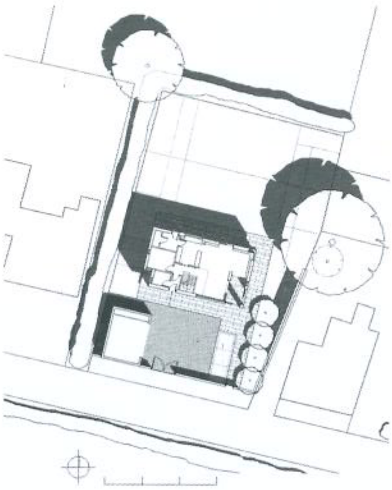
The 2020 house built by Richard Partington Architects for engineer Richard Quincey is designed to surpass sustainable building standards for many years to come. Photos: Paul Smoothy.

Thinking ahead



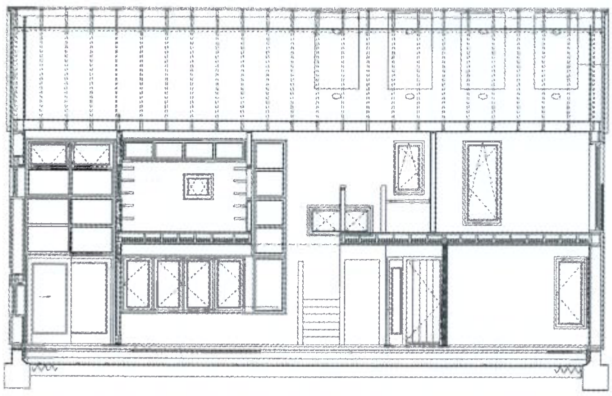
For us the 2020 house was a difficult proposition, *writes Richard Partington.* The house was to be an environmental model, ideal family home and self-build exemplar. The client was also a colleague and friend. Before we were appointed, the clients had prepared a comprehensive brief including information on site constraints, planning policy, preliminary thermal modelling, energy targets, weather data, cost plans and a programme. To accompany the technical information there was also an articulate appeal to create a humane contemporary design.

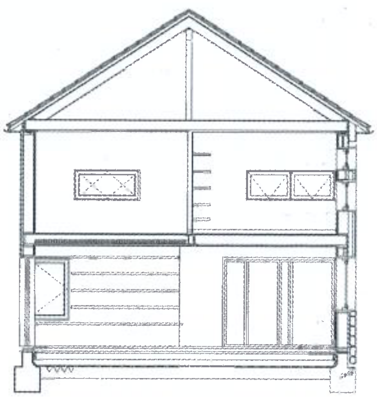
Although there was an outline consent for a single family dwelling, it took us longer than expected to secure planning – the site is just on the edge of a picturesque Devon village and the Parish Council took a while to embrace our deviation from the local stone and thatch vernacular. Externally the house adopts a functional form and modest appearance referring to simple barns and agricultural buildings with a large pitched roof, orientated so that one plane faces due south. Construction techniques and materials were more or less pre-determined by sustainability issues (super-insulated, light-weight construction), planning (the limited use of local natural stone) and site constraints (the position and level of the house for drainage and foundations).

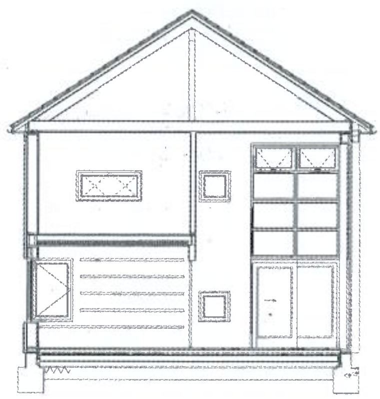
The design uses two large volumes within the house as part of a sophisticated environmental solution. The double-height stair hall forms the main space for the distribution of fresh air through positive input ventilation. All of the habitable rooms open directly from this space. The second volume is the double-height winter garden on the south-east corner, which acts as a thermal buffer in summer and a collector of passive solar energy in the heating season. The winter garden is a natural extension of the main living space, itself treated as a series of habitable areas, which can be interconnected or partially screened to create privacy when necessary. The north-east corner of the living space is snug and protected, lined with books and shelves, with just a small corner window at seated eye-level to frame a particular view. The dining area looks onto the garden and other parts open outwards with large windows to the southern courtyard and the winter garden. A cylindrical wood-burning stove provides a focus and can be rotated to face any part of the living area.

The master bedroom and the living area both have windows or double doors into the winter garden as well as views of the garden and spire of the village church. The double-height spaces on the south side allow daylight to penetrate deep into the plan, much as predicted in the preliminary modelling. Suspended on the first floor between the two volumes, the study is conceived as a timber-clad retreat, with a single square window, like le Corbusier's cabanon at Cap Martin. In

Above *South-facing elevation; the western red cedar-clad study is differentiated from surrounding glazing.*
Below *Left to right: Long section showing the two double-height volumes that form part of the environmental strategy; section through living area, study and bedroom; section through the double-height winter garden.*



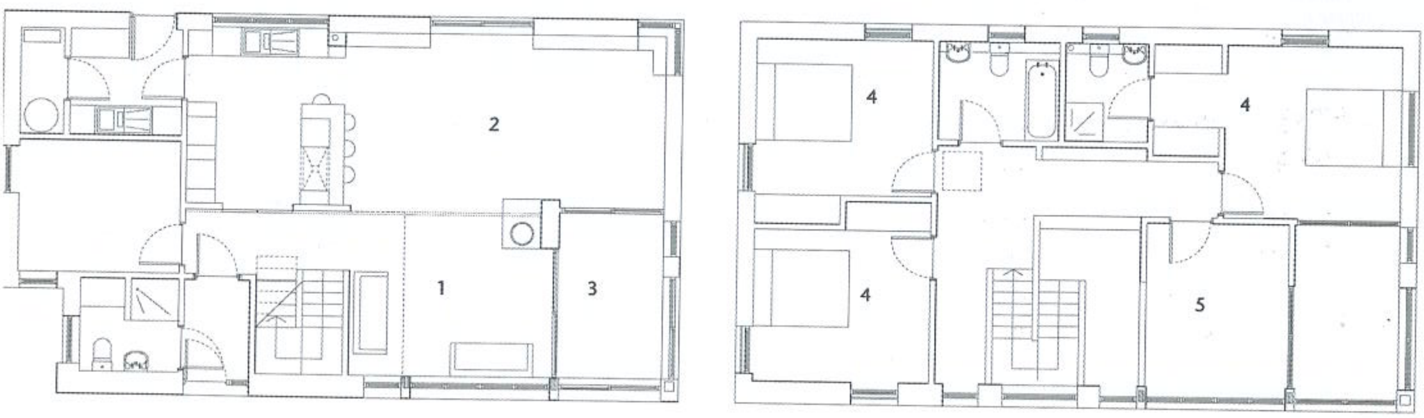




elevation, the timber boarding changes here from horizontal to vertical and the glazing frames the study on all four sides to emphasise the idea of a 'building within a building'.

Our main focus in the detailing of the external wall was to achieve a crisp and flush line to the cladding with deep recesses to the windows, and also to maintain air-tightness around all of the openings, service penetrations and changes in material. The wall is generally a panellised stud system with the timber boarding acting as a rainscreen with ventilation behind. The small area of stone on the south facade is built up from the ground in front of the timber panel with extra precautions taken to ensure that a 50mm gap was maintained even with the more irregularly shaped stones. Above the stone wall an oversize counter batten was used to space the timber boarding beyond the face of the stone and control rainwater run off. We deliberately extended the openings of the ground floor window and entrance door up to the underside of the first floor construction to avoid visible lintels and reinforce the stone's function as a facing rather than loading-bearing material. The windows are a good quality system using aluminium-faced Scandinavian softwood supplied by Rationel. The system was capable of achieving the large spans in the winter garden, with some additional bracing, and was also used for the sliding glazed doors internally, ensuring that there was a consistent finish to all the glazed elements. For a relatively simple house, we ended up with large number of window types – 26 in total. In part this is because the ventilation requirements and opening mechanisms were tailored to each situation (low level, high level, night vent, remote operation and so on) but also because the daylighting was modelled for each space and a more standardised type, applied to each room, would have

Above *View through the double-height living area to the winter garden. The first floor study has glazing on all four sides to indicate its status as a 'building within a building'. The wood-burning stove is directionally adjustable.*
Ground and first floor plans *1 double-height living area, 2 dining area, 3 winter garden, 4 bedrooms, 5 study.*



Richard Quincey writes:

The older you get, the more certain you become about what you want from a house, and often it's hard to find. I suspect that most people at some point think about building their own house to meet this need. Most don't because of the scarcity of suitable building plots. We were lucky, and found a south-facing plot with outline planning permission near the middle of a pretty Devon village.

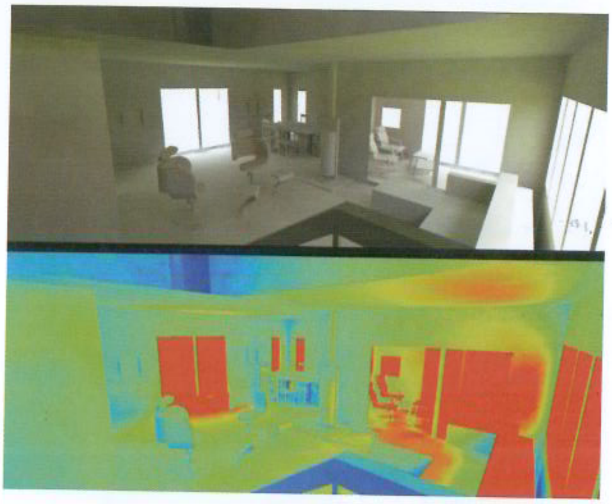
As a building engineer, I have seen the positive effects that really good architecture can have on people's lives. We wanted our children to grow up in stimulating and rich surroundings that address environmental issues sensibly. This added up to a brief for a very low energy house designed to exceed UK targets for many years to come, that was also affordable and aesthetically appealing. We selected an architect I know well and respect, one I was sure would be robust enough to take on my definite views and was capable of delivering on high expectations.

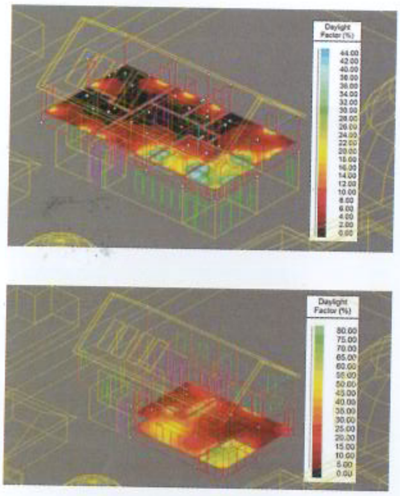
The concept is driven by a desire for a strong humane, contemporary architecture, bedded in local materials and forms, which is not hijacked by technology. This is important to me as many low energy houses in the past have been overwhelmed aesthetically by technology. Given the maturity of low-e products today, I would contend that this need not be the case; indeed, if we are to tackle the aspiration for low-e housing on a large scale, they really do need to work aesthetically. I also have a firm belief that 'bright and airy' spaces are fundamental to good building design, and set out to do this properly through extensive modelling.

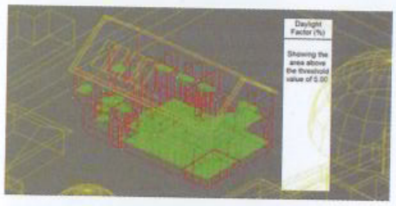
Fundamentally, houses are simple things to design. It is also relatively straightforward to make new houses consume very little. Going from consuming very little to consuming nothing is a far bigger step and costs a lot more. This design is fixed at an optimum 'very little', but arranged to allow for further renewable technologies – wind and photo-voltaics – to be added later when they are more affordable.

The building uses a number of simple and affordable holistic strategies to reduce its energy footprint to a low level. It is super-insulated to near the 'no heat standard' (Insulation for Sustainability – a study by XCO2 for BING), and has a panellised deep stud timber frame for low embodied energy. The external materials – timber cladding and local flint stone – require no maintenance, and the timber composite argon-filled low-e windows are part of a package of measures that provide very good physical air-tightness. The house makes use of simple passive solar design measures (but carefully as this building is not thermally heavyweight) and low energy positive input ventilation and heat recovery. Low energy and low water use appliances and sanitary-ware were specified, and low energy lighting (including some LED) installed. The organisation and arrangement of spaces also plays a part. An integrated winter garden buffer space provides protection from winter cold and summer overheating, while double-height spaces allow daylight penetration to the heart of the building. Rooms are arranged around the double height space for internal heat and air circulation.

Beyond these simple and affordable holistic strategies I have chosen what I consider are the best 'bang for buck' renewables to reduce the energy and carbon footprint to a very low level. These include two active solar systems by Nuaire – a solar air-based whole house ventilation and heating system (Ecosun) and a solar air-based whole-house ventilation and heating system with heat recovery and solar hot water system (Sunwarm). Both of these systems benefit from passive solar preheating, drawing fresh air via the winter garden. As the heating requirement is so low and the house is designed to allow heat to circulate, a simple very efficient log stove is provided in the main living space to heat the house. Any top-up for the heating and hot water is provided by a small, simple and highly efficient modulating electric boiler.







With a light-weight, highly insulated design with passive solar features there is a risk of summertime overheating and poor temperature control. This is countered by the winter garden, which provides solar protection, and a deep south facade whose window reveals provide a degree of shading. The layout promotes natural cross and stack ventilation and the windows are designed to be secure when open, so they can be used for ventilation at night and when the house is unoccupied.

With these arrangements the house achieves excellent day lighting and produces predicted carbon emissions of about 6 kgCO2/m²/yr (using the SAP method). This is about three times less than the new 2006 standard and maybe five or ten times less than a typical UK house. With an envisaged roof-mounted wind turbine, the carbon emissions would be roughly half this figure.

Efforts were also made to keep the construction process sustainable. Products were sourced locally wherever possible (the stone arrived by tractor). Waste on site was managed – in total only five medium-sized skips of waste were produced. In addition, many materials were manually sorted and recycled: foundation spill was redistributed on site and the excess used to create a hill for the children. Waste stone was all reused on site as hardcore or in soak-away details, while waste wood has been taken by neighbours, reused on site or kept for carcassing. Dropped nails and the like have been collected and reused. Carpet and floor samples have been returned to the supplier.

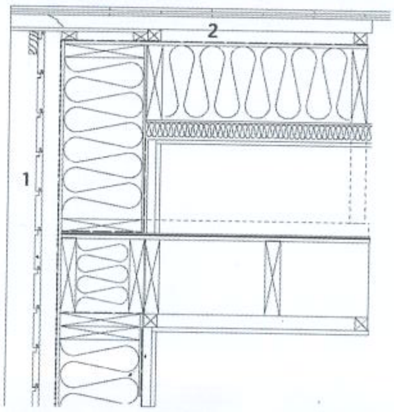
So what is it like to live in? The air tightness and insulation means outside noise rarely intrudes; you have to get used to seeing trees thrashing about in the wind outside and hearing very little. The central space is very well daylit with lots of internal vistas; its openness, however, does mean you can hear the dishwasher. Watching how the house responds to the weather is proving interesting – it is on dim, cold and wet days that you realise how much the solar air system is adding to the hot water and heating. It also takes a few days of such weather for the unheated house conditions to decay to the point where you need to wear more than a T-shirt. Generally, house temperatures are very stable and comfortable. My engineer's worry over summertime overheating and heat distribution to unheated bedrooms has been unwarranted. The winter garden really does work as a laundry drying space, and we are still able to grow chillis in October.

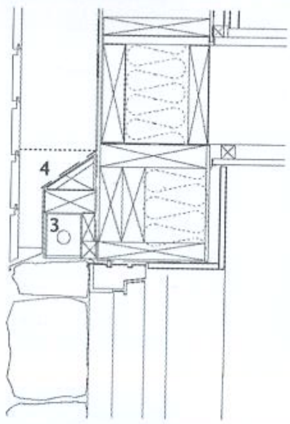
Top left *Daylight modelled in IES Virtual Environment; Daylight Factors colour-coded in the lower half.*
Middle left *Areas of glare identified in IES Virtual Environment.*
Bottom left *comparison of the daylight model with the house as built.*
Top right *Daylight Factors colour-coded on the first and, below, ground floors.*
Middle right *Daylight Factors above five per cent highlighted in green.*
Above *The house in its garden; the hill is made from site spoil.*

resulted in unsatisfactory lighting levels or unwanted solar gains.

We like to work with engineers in the early stages of a project to promote a close dependency between environment, structure and architecture. We had developed a good understanding on previous projects with Richard Quincey, who was the environmental engineer on our Parkmount low-energy housing scheme (AT 158). For us, the completeness of the brief and Richard's knowledge of design and construction were a blessing and only occasionally a hindrance when some decisions seemed predetermined and could not be pushed further – we were always slightly uncomfortable with the siting of the building 'mid plot', creating equally sized external spaces on each side of the house.

On reflection we agreed that there were uncomfortable moments in the design development and client discussions – we must have seemed quite defensive arguing for more intuitive ideas against Richard's objective analysis and formidable technical knowledge. However, these conflicts are to be expected and to some extent they were anticipated in the brief, which invited us to devise something more than a merely technical solution. The use of active and passive solar systems and the energy-saving achievements of the project are significant, but they do not come at the expense of architectural design. We are now developing, with Richard, a series of variations on the environmental systems that could be applied to volume and low cost housing including competition proposals for a suburban housing scheme for the Joseph Rowntree Foundation.





Verge detail *1: 19mm cedar cladding on 50 mm vertical batten, breather membrane, 9.2mm Panelvent, 235mm solid timber frame blown with insulation; 2: slates on 38mm tile battens; 75mm studs, breather membrane, 9.2mm Panelvent, 220mm rafters blown with insulation, 6mm Paneline, 45mm Celotex rigid insulation fixed to rafters, 12.5mm plasterboard.*
Entrance door head *3: Low wattage brick light concealed within wall thickness; 4 breather membrane to lap over preformed metal flashing, bottom board trimmed to form drip.*

Project team
Architect: Richard Partington Architects; designers: Richard Partington, Michelle Hotchkin, Doug Carson; design concept/m&e/structural engineer/geotech: Gifford; client: Richard and Louise Quincey.

Selected subcontractors and suppliers
Simulation software: IES Virtual Environment; solar system design: Sunwarm (Nuaire); timber frame design and build: Truhomes; glass balcony design: Dewhurst MacFarlane; roofing: Salter Roofing; electrician: Blackmore Electrical; groundworks/foundations: N&G Construction; stonework/general building works: JMS; windows: Rationel; ventilation/solar equipment: Nuaire Sunwarm plus and Ecosun; stainless solar cylinder: Kingsmark Design; underfloor heating/pipework: Osma; soil and waste: Hepworth; controls: Danfoss; flue: Ritevent; stove: Wendron Stoves – Hase Luno; electric top-up boiler: Trianco Aztec; wall insulation: Warmcell 500; roof/internal wall insulation: Rockwool Flexi; external breather membrane/internal airtight/vapour barrier: Tyvek; plasterboard: Fermacell; internal frame sheath: Paneline; external frame sheath: Panelvent; kitchen: Kitchenworld Exeter; granite: Devon Granite; western red cedar: Jewson Exeter/International Timber; lighting: Concord/Contract Lighting (Genesis 13); sanitaryware: Ifo (Green Building Store – basins & wcs) & Poreclanosa (bath & taps).