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SuperHomers embrace passive solar

Passive solar design is no longer limited to Passivhaus and new-build housing projects. It is creeping its way into domestic retrofit too. Homeowners, with the freedom to extend their properties and glaze a south facing façade, are starting to take greater advantage of the sun's light and warmth. This is reducing the need for artificial lighting, heating and cooling in their homes. Gordon Glass reports ...

At the forefront of this burgeoning interest in passive design you'll find a host of environmentalists, architects, green builders and scientists. You'll also find two early adopters, Kit Knowles and Paul Capel, whose homes were awarded SuperHome status. SuperHomes are older homes, refurbished by their owners for greater comfort, lower bills and significantly reduced carbon emissions - at least 60% less. Not surprisingly, the SuperHomes network tends to attract homeowners like Kit and Paul - both of whom have been eager to experiment when planning their home refurbishment.

Chortonville SuperHome

SuperHomers Kit and Ellie Knowles own a 1909 arts and crafts property in Chorltonville, which is part of an on-going experiment in eco renovation. This is a solid brick-walled semi-detached house in a conservation area. Amazingly it already boasts over 100 different energy saving features, although great care has been taken to maintain its period charm.

Thin aerogel insulation has been used on the outside of the external walls, claiming to deliver the same thermal

performance as 200mm of mineral wool in just 58mm including render. The original stained glass windows have been kept and a process of encapsulation has been used to improve their performance. "This also protects them from decay and oxidisation", says Kit.

A log burning stove, one of the most efficient of its type at 93% efficiency, is installed in the lounge. At present there are no other renewable technologies installed. The gas boiler is typically used only to heat water and is only needed for space heating in the depths of winter - as little as 5 days a year! The gas bill has been cut to just £150 a year. The electricity bill is around £400 a year, helped by the extensive use of 'A' rated appliances throughout.

However, it is the passive design focus within this property that most thrills visitors. Downstairs a beautiful kitchen/diner space, which opens to the lounge, has been created. Dubbed 'the solarium', this space uses passive design to capture solar energy, store it and distribute it across space (from the south to the north of the building) and across time (from midday to midnight). Kit often refers to it as the engine room of the house, so capable is it of generating energy.

The design stores some of the sun's warmth during the day for release in the evening and into the night. In the solarium a pitched glazed roof rises high above head height. Exposed brickwork there absorbs the heat during the day. At night the bricks release this warmth like a hot water bottle as the surrounding air temperature drops. The floor, which is matt black slate, similarly absorbs heat from the sun during the day, ready for evening use.

A partition wall has been removed to create the larger





downstairs lounge/diner/kitchen area. The advantage of this larger, open plan space is that it allows the sun's warmth to move around the downstairs during the day. It also allows for sociable cooking and relaxation.

Another comfort feature is the pitch of the glazed roof, which has been deliberately raised so it collects warm air high above head height. This reduces potential discomfort on hot sunny days, since excessive heat is normally experienced at head height.

"Glazing is essential for solar collection in the UK", says Kit, "but it isn't so good for retention". One answer, he says, is to use low emissivity coatings on triple glazing - these can help reduce overheating in the summer and retain heat in the winter. He has opted to install thermal blinds. His windows are near Passivhaus standard.

A fairly traditional approach to laying the floor in the extension has been used. This involved pouring a 125mm concrete slab (in this case reinforced and lower carbon), then covering it with sheet insulation, adding 75mm of screed with cement and topping with tiles.

Kit now thinks it would have been better to put the insulation under the concrete slab, so that the entire thermal mass of the slab would become available for solar heat storage. This can be achieved with insulation which is closed cell, impervious to water and designed not to compress under the weight of the poured concrete. In this case the insulation is simply installed on top of the damp proof membrane, which he suggests doubling for certainty.

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What is the SuperHomes network?

The SuperHomes network harnesses the enthusiasm of pioneering households to demonstrate the benefits of switching to low energy living. They welcome visitors. Touring a SuperHome provides actionable ideas for greening your own home. You will also see many of the home improvements eligible for support under the government's Green Deal scheme. SuperHomers can tell you about both the challenges and the financial and environmental benefits of eco refurbishment.

SuperHomes is a Sustainable Energy Academy (SEA) initiative. There are currently 135 SuperHomes in the network. Amongst those on show, you'll find renovated Georgian, Victorian, Edwardian and post-war properties. Most have superior insulation. Many have alternative heating sources and some produce their own energy.

SuperHomes has already won multiple awards, including an Ashden Award for Sustainable Energy in 2009. It has been celebrated for being the first network to make exemplar refurbished older homes open to the public so that people can have a touch and feel experience, and be inspired to take action in their own dwellings.

SEA is a registered charity dedicated to reducing the carbon footprint of buildings. By 2020 it aims to increase the network size to 500 SuperHomes, local and publicly accessible, within 15 minutes, to nearly everyone in the country.

What is a 'SuperHome'?

This is the terminology specifically used by SEA for a home which achieves a minimum 60% carbon saving on site, and which is open to the public at least once a year.

What is an 'exemplar' home?

This is a more generic term for a home which achieves a high level of energy efficiency and is used to showcase or trial energy saving and low carbon technologies.

Kit has installed a really deep layer of perimeter insulation in the footings, as in many respects lateral heat loss, rather than heat loss into the ground should be more of a concern when using a floor as a thermal store. You don't have to go down far before the ground is a steady 10-12°C. So, under normal circumstances, heat loss going down will stop at 70cm depth. At this point heat loss at the perimeter becomes the main concern.

MVHR (mechanical ventilation with heat recovery) has also been installed. This compliments the natural distribution of warmth by using pipes and ducts to collect warm moist air and redistribute the warmth to cooler, drier areas of the house.

The active MVHR system removes any overheated air from the solarium and distributes it throughout the entire property to every room in the form of pre-warmed fresh air. Kit says that, in general, there is very little temperature swing across the house and no draughts. Comfort levels are therefore greatly improved, especially considering the property is over 100 years old.

"Distribution throughout an entire property is difficult through passive means", Kit warns. As a result we are increasingly seeing MVHR installed alongside passive solar design. It is practical where a relatively airtight building fabric has been created and every effort is being made to capitalise on solar gains.

One of his plans for the future is to integrate a zeolite module with his MVHR and a new photovoltaic solar thermal (PVT) system. Zeolites are naturally occurring materials. They absorb water and give off heat or release water as vapour when heated. Kit believes this two way reversible action has great potential for energy saving when utilised as a form of heat storage.

Once installed the zeolite should make the MVHR even more efficient. In winter, as humid air is extracted from the property, it will pass through the zeolite, which will absorb the moisture and give off heat. Low grade winter heat, generated by the PVT panel will be fed to the zeolite to recharge it, giving a greater pre-heat to incoming air as it passes through the MVHR's heat exchanger.

Having been through a major refurbishment project, Kit Knowles now runs his own business, Ecospheric Ltd¹, giving clients advice on retrofitting their own properties. Kit's science background doubtless comes in handy for metering energy losses and weighing up technical solutions. However, his SuperHome also displays a real talent for interior design. Does his wife Ellie have something to do with that? You'll have to ask to find out.

Walter's Way SuperHome

Paul Capel's renovation project was fittingly experimental, given the already unconventional house design. The house is one of thirteen Walter Segal, self-build properties constructed in 1985/6 in Walter's Way, Lewisham. These houses are timber framed and modular. They are also raised on stilts. This has the advantage that they can be built amongst trees, on a hill.

The renovation started with the basics - improving the fabric of the house. "If you've got a very high quality envelope you don't require a huge amount of energy to keep it warm or to keep it cool", explains Paul. "We didn't make an airtight layer all round the house - the density and the thickness of the insulation materials has the same kind of effect, but it does breathe as well."

The floor, walls and roof were insulated first. The wall and roof insulation was fitted externally, using two 100mm layers of dense wood waste material. The walls were then lime rendered on the outside.

A solar thermal system now connects to a heat store.



It supports underfloor heating in winter and domestic hot water in summer. Mechanical ventilation and heat recovery is installed. Paul turns this on in winter to minimise heat loss and to maintain interior air quality. A 2kWp PV system is also fitted.

However, the standout feature of this renovation, like with Kit's, is related to the use of passive solar design. It is the combination of triple glazing behind a single glazed two storey, 'solar chimney or glass box' (as Paul likes to call it). This is essentially single glazed conservatory space, measuring about 3m x 1.5m on plan that can be closed off from the main house in really cold weather but opened for through ventilation or for sitting in on nicer days (see inset photo below). The result is stunning. This wall of south facing glass attracts both natural light and solar gain. In summer you can walk through into the single glazed solar chimney and out to the balcony and garden.

Making use of passive stack ventilation

Most homes with extensive glazing on the southern aspect risk overheating at the height of summer. However, passive solar design, such as used here on Paul's home, can

overcome potential overheating by the careful positioning of ventilation routes, ie. by exploiting the fact that high pressure hot air expands into areas where the air is cooler and pressure is lower. So hot air has the tendency to rise - Paul calls it his 'solar chimney'.

If you can create heat and pressure within a confined space, and give the air only a vertical escape route, the air will travel upwards at speed. This upward movement can produce a cooling effect as the hot air travels up drawing in cooler air behind it - which itself then heats up, maintaining the movement. This is a useful way of evacuating warm humid air skyward, to be replaced by cool fresh air from trickle vents and wall inlets. Paul Capel's SuperHome uses this fact to its advantage with its unique solar chimney.

Aside from the increased comfort and lower bills, Paul considers the increased use of passive cooling and heating to be one of the big wins of the refurbishment.

His unique solar chimney functions in several ways. Firstly, it can be used to draw warmer air from the interior up and out at the top in summer. As a result overheating is never a problem, which is surprising given the radiant heat from the inside heat store. Secondly, it means a column of self-replenishing warm air is available on sunny winter's days. This can be drawn into the interior by briefly opening one of the triple glazed units it surrounds.

Visit Kit and Paul's SuperHomes

Kit and Paul's homes are just two of some 135 homes which have been awarded SuperHome status. You can visit many of these in March and September each year when SuperHomers host free open days. You can also watch full length flythrough videos and read more about both homes. For Paul's home see www.superhomes.org.uk/86. For Kit's home see www.superhomes.org.uk/93. Paul Capel will be hosting an open day on Sunday 23 September.

Gordon Glass

Browse the SuperHomes website for homes to visit near you.
WWW.SUPERHOMES.ORG.UK

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1. WWW.ECOSPHERIC.CO.UK

Gordon Glass moved into the field of energy saving in 2005 having previously worked in the arts. He is currently online marketing manager for the Sustainable Energy Academy.

