

5th Passivhaus Conference



Listening to the speakers at the 5th Passive House Conference near Stuttgart in Germany (16-18th February 2001), one quickly appreciates why this is becoming such a significant annual event for energy-efficient buildings. The scope of the Conference, with more than 400 construction industry professionals in attendance, underlined the major impact that passive houses are making in mainland Europe. **Brian and Sibylle Rushbridge** report...

In addition to the daily plenary sessions, there were parallel topic-oriented meetings providing key updates on case histories, developments in passive house architecture, building practice, construction techniques, modernisation, heat-exchange ventilation systems, and user experience, as well as the sharing of information in the accompanying exhibition.

The enthusiasm of the delegates clearly reflected the positive effects of both government push and consumer pull for low-energy solutions. With growing demand in both the domestic and commercial sectors, the construction industry is responding partly willingly, and partly out of necessity.

Following on from David Olivier's up-beat report about last year's meeting (Building for a Future, Summer 2000, page 10), we attended this year's conference with David.

The expression 'passive house' was adopted for standards set by the Passivhaus Institut in Darmstadt,

a technical research institution originally linked to the state government. For more than a decade, a team led by Dr Feist assessed all the elements involved in house construction, with the aim of selecting and developing more energy-efficient methods and components.

They built the first passive building in Germany in 1991, as a terrace of four houses. Within ten years, the houses have become an international benchmark for energy-efficiency, with projects underway not just in German-speaking countries but also in the Netherlands, France, Sweden and others.

Any space heating requirement which is smaller than the 15kWh/m²yr limit, can be met by occasional warming of the ventilation air. The passive house standard of 15kWh/m²yr for space heating is significant because it is the threshold level where conventional central heating systems become unnecessary.

Current new UK houses on the other hand, need

an estimated 120 - 200kWh/m²yr for space heating alone. (This range is based on indirect calculations, as there is a dearth of actual measurements.)

So the term 'passive house', as used by the Passivhaus Institut, is neither a system nor a particular design, but rather it is a voluntary energy standard for any building. It arises from the fact that the building becomes 'passive' with regard to space heating.

These well-defined energy targets have led to a standard which can be readily understood by industry, government and consumers. The advantage of such an energy standard cannot be over emphasised. It avoids confusion or misinformation about the energy performance of a passive house, and provides the motivation for the progress in energy efficiency and the increase of passive houses in mainland Europe.

A wide range of new design and component improvements have been used to achieve this

The fundamental definition for Passivhaus buildings is based on the energy used annually during normal occupancy. The energy requirement must not exceed 15kWh/m²/a for the space heating or cooling; nor must it exceed 30kWh/m²/a for the total energy requirement, including space heating or cooling.

standard. Component manufacturers are quickly entering the market with improved products and materials. Whilst the Passivhaus Institut remains the 'focus' of the passive house movement, many other research organisations and universities, as well as government, construction and industry groups are very active, particularly in Germany, Austria, and Switzerland.

All of these parameters in the box on page 10 are well in excess of the UK's likely L regulations for 2001, and beyond what many in the UK industry will say is reasonable or achievable. However, the acceptance and rapid uptake of this standard, particularly in Germany, as well as Austria and Switzerland, show how government incentives have achieved the desired results. They have created consumer demand, and opportunities for design skills and manufacturing entrepreneurship.

Conference messages

Increased construction

Emphasising the support of government for passive buildings, the Conference was opened by the Minister for Housing from the host state of Baden-Württemberg. His message about the value of the standard in the social housing sector was very positive. The state is training site workers specifically for passive house construction.

The build predictions for 2000/2001 made at last year's Conference have not only been met but exceeded. More than 1000 dwellings, built to the passive house standard, are known to have been completed.

In addition, many houses are being built without further reference to the Passivhaus Institut by architects and construction professionals who have successfully completed earlier buildings with the Passivhaus Institut or with similar help. With this growing confidence and the acceptance of passive houses in the mainstream housing sector, it is likely that future numbers of completed passive houses will become underestimated.

The large number and geographical spread of demonstration passive houses is making it much easier for the general public to see one in their vicinity. This, in turn, facilitates the appreciation of the comfort and cost savings, thereby feeding the demand loop for yet more passive houses.

Styles and materials

Based on the experience gained, it is claimed that every new building is capable of being designed to passive house standards, independent of its location in Europe, and largely independent of its use.

The passive house standard can be achieved with a wide variety of construction materials, and be used in widely differing aesthetic designs, local styles and a variety of building types. The scope is endless. Built types already cover detached and semi-detached homes, terraces, flats, commercial offices and factories, schools and play groups, student homes and conference buildings.

Information

Details of a range of buildings which have been built to the passive house standard are provided on the Passivhaus Institut website. We also found a new book called 'The Passive House - Living without Heating' with photographs, technical details and costs of more than twenty finished passive houses. In Germany, unlike the UK, costs of new buildings include VAT of 16%.

The Passivhaus Institut has become an established certifier of construction components which meet the passive house standard. This gives architects and specifiers ready access to high-performance certified components, without time-consuming appraisals of suppliers' publicity. Certified components include insulation systems, windows (with the U-values including their frames, in contrast to some UK advertising), doors (also with their frames), heat-recovery units and heat pumps.

Some conference topics

Measurements increase confidence

Measurements on sites where a large number of units have been built (e.g. 52 on one site, 104 on another), have proved valuable to establish variations in energy and occupant use. On one site, further comparisons were possible with an additional group of houses where the ventilation is controlled by humidistats. On another site, a block of flats had to be designed with facades facing mainly east or west, as prescribed by the local plan, rather than the optimum south-north orientation.

Most of these varied projects are being monitored by accredited bodies, supported financially by

the German Department of Industry and others. With this degree of commitment, quantitative feedback is assured, leading to even greater confidence in the future of the passive house standard.

Wide choice of windows

With an increasing market, costs for passive house components are decreasing, and the range of choices is increasing. The number of windows of passive house standard (U-value of less than 0.8 W/m²K for window and frame combined) has increased to 20 varieties, made from wood, reclaimed polyurethane and PVC - and even includes one with metal frames which contain a new high-efficiency insulation material as a thermal break. By contrast, we have yet to find one UK manufacturer who can approach the passive house standard even halfway, i.e. reduce the energy loss by a factor of two.

Coatings for glazing

Tests have been carried out with new coatings on glazing which offer less resistance to incoming solar energy, but the same resistance to long-wave heat loss. In other tests, thermal stresses are being investigated further and will hopefully be clarified once and for all.

Improved living standards

The improved living standard, ventilation and comfort of a passive house was a clear and oft-repeated message at the Conference. This was supported by facts and figures, as well as by a round-table session of frank and articulate passive house occupants.

From time to time, we have encountered people in the UK who believe that passive houses equate to frugal living standards and low comfort levels. They quote examples of greatly reduced window sizes, as a short cut to meeting our energy regulations, resulting in dark houses, and seem to assume that the same happens abroad, particularly where the energy standards are tougher. Comments about thermal underwear and troglodytes abound.

Nothing could be further from the truth! Our knowledge of these houses and, more importantly, the experience of their occupants counter these misconceptions. Passive houses tend to use large south-facing windows as part of the energy

A house which meets the passive house standard will combine a number of effective features. In particular, it is important to

- **optimise site orientation for maximum solar gain, without over-heating,**
- **adopt careful workmanship and construction techniques on site,**
- **monitor quality during all stages of the construction process,**
- **use effective insulation for the building envelope, (ie U-values of 0.10 W/m²K for the floor, walls and roof, and 0.8 W/m²K for the windows and frames),**
- **design out cold bridges, (ie undesirable heat loss due to heat transfer from the inner wall etc to the outside),**
- **design in air-tightness, and confirm by tests on site, (ie maximum of 0.6 air changes per hour with the whole house pressurised to 50 pascals),**
- **specify high-efficiency (> 80%) heat-recovery systems, to ensure controlled ventilation and to recover heat from incoming fresh air and outgoing stale air ; these may use no more than 0.45W per m₃ per hour of air moved.**

saving system. Further, because of the warm window surfaces and the other energy-saving factors mentioned, window space can be generous, and the

houses light and comfortable. Some German owners commented that the interior of passive houses was like permanent summer - all the rooms were warmer and more comfortable than normal houses.

Opening windows?

There is also confusion in the public's mind about whether the windows may be opened. Neither the passive house standard, nor the European standard EN832, require the windows to be shut at all times, and continuous measurements carried out in over 100 passive houses have not shown any problems with opened windows ... except for one family which left its door ajar all winter for the cat !

Forecast of energy usage

With thorough validation, the mathematical model of the passive house standard has become an accurate design tool for very realistic energy usage forecasts. This achievement is not reached by other standards, including DIN 4108 / part 6.

Recent component developments

- Various producers have tailored and optimised external insulation for passive houses.
- A system of aerated monolithic concrete has been certified for the passive house standard,

and is now available for detached houses.

- Further concrete wall permanent shuttering systems have been certified. The companies involved report that the amount of formers of passive house standard - 250 - 300mm of wall insulation instead of 100 - 150mm - has reached 50% of their turnover.
- The availability of wood panels of passive house standard has increased greatly in 2000. The details of wooden I-beams have been developed and improved further, again specifically for the passive house market.
- Pre-fabricated concrete panels with integrated insulation have also progressed.
- So have calcium silicate blocks and storey-height units. Calcium silicate is the most common external wall material in German passive houses, and has quite a low ecological impact, but it has disappeared from the market in the UK.
- Vacuumised insulating panels, which may be particularly useful where space is at a premium, are undergoing trials. For example, in the renovation of old buildings, where 300mm insulation is rarely achievable, the required insulation values can be obtained with only 40 to 60mm of the vacuum product. Its thermal conductivity is claimed to be 0.004 to 0.008W/mK.

Financial incentives

German government financial incentives for low energy and passive houses are open to all, but for many years they were, on the whole, only taken up by self-builders. Thus, by supporting the self-builders, the government neatly side-stepped the mainstream construction industry's resistance (yes - opposition exists in Germany too), and created a consumer-led standard which the construction industry has had to accept.

Continuing grants and tax incentives are speeding the demand for these buildings, as is the higher standard of comfort compared with ordinary buildings. When the client specifies a 'comfortable' home, architects are finding that a home built to the passive house standard will readily satisfy this basic criterion.





Building costs fall

In the private housing sector, the present slight on-costs, which are reflected in a higher mortgage, are less than the combined gain from the financial incentives and the lower fuel bills. In the social housing sector, one major speculative builder, whose blocks of flats we saw last year, is reported as being well on the way to achieving a remarkable DM1 000/m² (about £333/m²) construction-only cost (including VAT).

The next step - renovation

With the passive house standard established for new buildings, attention is moving to the upgrading of old buildings. Rather than a piecemeal approach, it is likely that this needs to be done as an overall scheme for each situation, so that the basic issues of upgrading the structure, eg insulation levels, and air-tightness combined with heat-recovery ventilation, can be addressed as a whole.

Implications and comment

The progress of the passive house standard in mainland Europe is now very significant, even though it is voluntary and far exceeds both the German 1995 Building Code and their new 2002 Building Code. This progress is clearly due to it being seen as a worthwhile energy target by the government. In view of the increasing voluntary uptake, we believe that the passive house standard will follow the 'low-energy' house in becoming a national standard in the not too distant future.

Here in the UK, it would help all of us if:

- we heard more about these improved building methods and standards
- our government followed the lead of other countries, which provide financial incentives to generate consumer demand and manufacturing opportunity, thereby circumventing opposition from certain sectors of industry
- components were available locally (so that potential passive house owners need not import the key components, to the detriment of future UK entrepreneurs who will find this new market already filled by mainland Europe suppliers - as happened with wind turbines, where lack of UK support led to a market dominance by Denmark).

Why this is not happening, we leave you to work



out for yourselves, because we can find no logical justification. As things stand, it seems, as usual, to be the generally more innovative self-builders who are the main 'shakers and movers', who are willing to put these improved standards into practice, and who lead the way in heating-energy reduction.

Seen in the context of the new houses planned by the government for the next ten years, the energy savings of passive houses would result in massive reductions of carbon dioxide emissions. However, instead of aiming for these energy reductions, the government seems to be focussing on energy generation, through photovoltaics (about £20 000 per house to cover part of its electricity requirements) and dwellings heated by so-called 'carbon neutral' fuel (wood, electricity from nuclear power, other biomass, wind etc).

How much better it would be, both for our pockets and for the environment, if we followed the continental example and built houses which largely avoid the need for such fuels in the first place!

The conference language was German, and the 2002 Conference will be in Basel - the German-speaking world again. Perhaps, one day, UK enthusiasm for such buildings will develop to the extent that a passive house conference can be run in

English... we are ever optimistic !

Brian and Sibylle Rushbridge

Further information :

1. Erneuerbare Energien, Kommunikations- und Informationsservice GmbH, 5th Passive House Conference and Proceedings, February 2001, (www.energie-server.de).
2. Passivhaus Institut, Darmstadt: www.passiv.de.
Built projects: www.passiv.de/projekte/projekte.htm
www.passivehaus-info.de/index_gebaubte_projekte.htm
('gebaubte' will eventually be changed to 'gebaute')
3. Energie Effizientes Bauen Verlag GmbH, (www.energie.effizientes.bauen@t-online.de).
4. 'Gestaltungsgrundlagen Passivhäuser' Wolfgang Feist, Verlag Das Beispiel GmbH, 2000 (available from 2. above).
5. 'Das Passivhaus - Wohnen ohne Heizung', Anton Graf, Callwey Verlag, 2000, (www.callwey.de).

Photos: this article and cover photos courtesy of Jorg Pfaffinger