PICTURE: F.Freundorfer, www.passivhauskreis.de




The Inbuilt Passivhaus

An intelligent approach to healthy, comfortable, ultra low-energy buildings and homes.

Passivhaus is a design methodology and rigorous, voluntary performance standard for energy use in buildings.

It results in **buildings that require little or no energy use for heating or cooling**, have excellent internal thermal comfort and low primary energy use.

The standard is achieved by meeting targets for:

- Space heating demand less than 15 kWh/m^2/year
- Primary energy use (heating, lighting, domestic hot water, appliances) less than 120 kWh/m^2/year
- As-built air tightness of less than 0.6 ach^{-1} @ 50Pa (~1m^3/h/m^2).

Compliance with these targets is verified using the Passivhaus Planning Package (PHPP) throughout the design and construction process.

The Passivhaus approach is proven to work and is now widespread. Since the first Passivhaus was built in Germany in 1990 there are now 15,000-20,000 Passivhaus buildings across Europe. As of October 2008 there were no certified Passivhaus buildings in the UK but several schemes are in planning.

Most Passivhaus buildings are new-build houses or apartments but refurbishment projects, schools, offices, sports centres and fire stations have also been built to the standard.

The Inbuilt Passivhaus is designed to the most exacting standards ensuring that health, comfort and genuine sustainability are guaranteed - on top of the normal Passivhaus requirements.

The Inbuilt Passivhaus is designed to ensure that owners and tenants get outstanding performance;

- Internal pollutants are minimised ensuring excellent indoor air quality
- Greenhouse gas emissions are reduced in construction and operation
- Overheating risk is minimised through advanced thermal modelling
- An approach is taken which aligns with the Code for Sustainable Homes requirements.

How to design a Passivhaus

Provided a design meets the performance criteria and is modeled in PHPP, the designer has a high degree of flexibility in designing a Passivhaus as they wish. However all projects share some characteristics and typically the performance criteria can be delivered by following these six steps:

1. Optimising a building's shape and orientation to reduce heat loss and maximize solar gain…

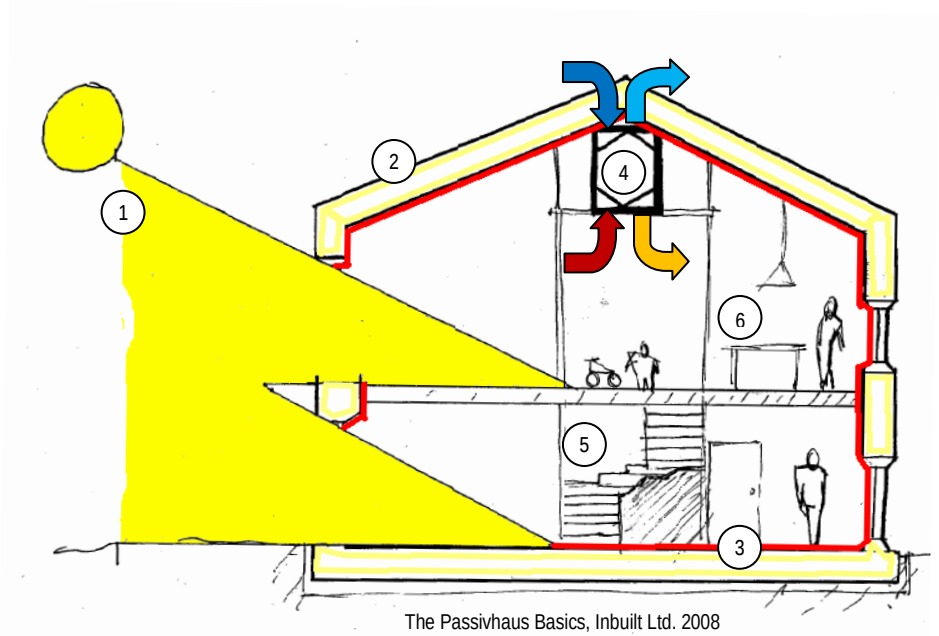
    - Designing "compact" forms with minimal surface to volume ratios.
    - Sizing south facing glazing to "capture" solar heat gains whilst at the same time avoiding summer overheating.
    - "Huddling" buildings together to reduce exposed areas.

2. Super insulating the building fabric…

    - Low wall, roof and floor U-values, typically 0.1-0.15 W/m^{2}K, 300-500mm of insulation.
    - Thermal bridge-free construction.
    - High specification glazing with whole window U-values typically less than 0.8 W/m^{2}K.

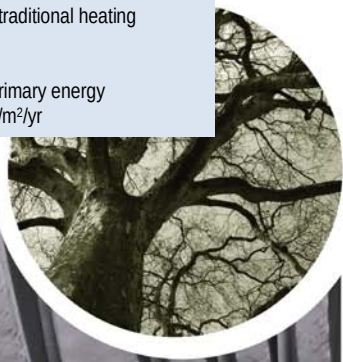
3. Reducing ventilation heat loss with an airtight fabric...

    - Reduce air permeability below 0.6 ach^{-1} @ 50Pa (6-10 times better than standard UK construction) and guarantee this performance by air pressure testing.



The Passivhaus Basics, Inbuilt Ltd. 2008

1. Optimise the building's form and orientation to reduce heat loss and maximise solar gain.
2. Super insulation <0.15W/m^{2}K and triple glazing (<0.8 W/m^{2}K, with no thermal bridging)
3. Airtight fabric <0.6 ach ~ 1m^2/h/m^3
4. Mechanical ventilation and heat recovery >75% efficiency.
5. Meet the reduced heat demand without a traditional heating system.
6. Reduce primary energy <120kWh/m^2/yr



Two Passivhaus Myths

You can't open the windows!

Windows can be opened in Passivhaus buildings but in practice most occupants choose to keep them closed as continuous fresh air is provided by mechanical ventilation, comfort levels are very high and the air quality is very good. In summer, opening windows at night will help keep the house cool but in winter doing so may increase fuel costs for the resident as heat will be needed to warm the house back up again.

They don't have a heating system!

It's true Passivhaus buldings don't have a traditional central heating system. Instead they have smaller, lower cost heating systems which can meet the reduced heat demand. On the coldest days, a single radiator in the bathroom and post-air heater in the ventilation duct is usually enough heat to keep the house warm and comfortable.

4. Providing continuous fresh air with mechanical ventilation and heat recovery...

- An 80-90% efficient heat exchanger and mechanical ventilation ensure that the home is superbly ventilated without increased heat loss. Correct design and installation of the low power fans and ducting ensures the system runs silently.
- In summer occupants can choose to ventilate the house by opening windows instead of relying on the mechanical system (or switch the system onto extract only mode).

5. Meeting the greatly reduced heating demand without a traditional large central heating system…

- The heating load is reduced by 80-90% compared to a standard building (a few candles could heat a room!). This can be met with, for example, a biomass wood-burning stove, small low temperature radiators or air source heating in the ventilation duct.
- Draughts and cold zones next to windows are eliminated.
- The capital cost of the heating system is reduced.

6. Reducing primary energy demand to less than 120kWh//m^2/year and applying renewable energy systems when appropriate...

- Specify low energy light fittings and appliances.
- Insulate domestic hot water pipes and cylinders.
- Provide hot water with solar thermal panels and storage.
- Further reduce CO_2 emissions with renewable energy systems.

Designing and constructing a Passivhaus isn't simple. It requires specialist skills in airtight design and construction, thermal bridge-free detailing and understanding of the PHPP. Through our design and consultancy services Inbuilt can apply this expertise to your projects.

Why design a Passivhaus when the Code exists?

Passivhaus complements rather than replaces the Code for Sustainable Homes. Whilst the Code measures success through reductions in carbon dioxide emissions and sets targets for wider environmental concerns, Passivhaus is solely concerned with minimising the energy demand in buildings.

Passivhaus complements the Code

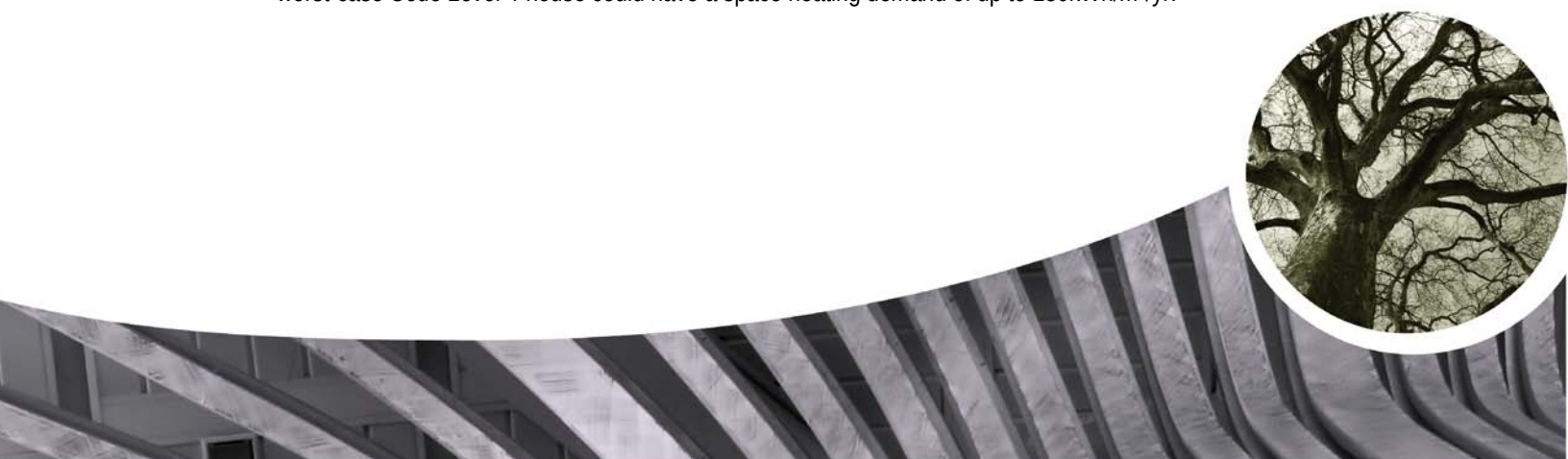
- A well designed Passivhaus will achieve the energy credits needed to achieve Code level 4 of the Code for Sustainable Homes and with minimal uplift can be improved to reach Code level 5.
- The Code uses SAP (the Government's preferred energy modeling tool) to estimate a building's energy use and carbon dioxide emissions. Passivhaus relies on a more sophisticated tool, the Passivhaus Planning Package (PHPP) which is sensitive to location, overshading and orientation and is a more reliable indicator of the actual performance of the building.
- PHPP is more easily integrated into the design process than SAP. While SAP was created as a 'compliance tool' PHPP is used by designers from 'concept development' through to 'detailed design', ensuring that the performance targets are met without stifling architectural expression.

Passivhaus encourages energy conservation before energy generation

- Code level 4 ENE1 credits can be met through renewable energy alone without improving the building fabric above Building Regulations. A 'bolt-on' renewables approach can be capital intensive (e.g. photovoltaics) or leave residents with high heating bills and inconvenient maintenance (e.g. biomass). Passivhaus delivers Code level 4 performance using proven and reliable technologies and passive energy sources (solar and internal heat gains) to reduce a householders heating bills and carbon footprint.

Passivhaus buildings protect residents against fuel poverty

- The ultra-low heating demand of a Passivhaus means that space heating costs are greatly reduced. Experience from Germany shows that some householders are so comfortable that they can do without heating entirely.
- For those that do want additional heating, the low heating demand of less than 15kWh per square metre per year means that annual fuel costs are reduced by a factor of 5-10. For example a household living in a 70m^2 Passivhaus with gas heating could spend as little as £25 on space heating each year. Good performance against Code criteria doesn't guarantee low fuel costs. Whilst Passivhaus space heating is limited to 15kWh/m^2/year, a worst-case *Code Level 4* house could have a space heating demand of up to 130kWh/m^2/yr.



Passivhaus delivers exceptional internal air quality and thermal comfort

- Throughout the year continuous fresh filtered air is delivered to occupants through mechanical ventilation with heat recovery (MVHR). MVHR ensures a healthy indoor environment and has been shown to substantially reduce the risk and instances of asthma.
- Variations in temperature throughout the home are greatly reduced so even on the coldest days the areas beside windows are warm and comfortable and there are no draughts.
- Climate change means hotter summers. Keeping houses cool and comfortable in high temperatures is a challenge. Like a thermos flask, Passivhaus buildings keep what's inside warm or cool longer. So on a hot summer's day, a Passivhaus with appropriate ventilation, shading and thermal mass will be more comfortable than a "standard" building with a less insulation and higher infiltration (more draughts and leaks).
- Disruption of electricity supply may become more prevalent in the future. Passivhaus buildings offer far higher resilience, survivability and comfort in extreme conditions. In the event of a prolonged power supply interruption, the risks associated with hypothermia in the winter or heat-stress in the summer are significantly reduced; either of these extremes can be life-threatening to the elderly or infirm.

Passivhaus buildings are a long term investment

- Passivhaus is the "Mercedes Benz" of housing. As each and every junction, window, door and ventilation pipe plays its part in the building's energy strategy attention to detail is vital. The combination of thermal bridge-free construction, airtight junctions and high specification glazing, doors and fabric means that Passivhaus buildings are robust and durable and 'feel' high quality.
- In a Passivhaus the best building fabric is specified, saving the next generation the economic burden and disruption of energy refurbishments in the future. If residents wish to make further energy and carbon savings later additional renewable energy systems can be considered.

Conclusions

- Passivhaus is a proven and deliverable design-based approach to low energy, low carbon building design.
- Passivhaus homes typically have a space heating demand that is 5-10 times lower than homes built to current Building Regulations.
- By maximizing energy savings, a householders fuels costs are greatly reduced, helping to protect against fuel poverty.
- Passivhaus buildings offer occupants excellent thermal comfort, good ventilation and quality construction.

PASSIVHAUS SERVICES

For Developers, Architects and Contractors

1 THE COMPLETE PASSIVHAUS DESIGN SERVICE

As experts in the design of sustainable built environments, Inbuilt's team of consultants and technicians can design and help deliver a Passivhaus home, school or office. They don't need to be new, we can even do refurbishments.

Partnering with architects when necessary, we provide design support throughout the project. Together we can provide the concept design, specification and drawing details which are vital to achieve the Passivhaus standard. These include Passivhaus Planning Package (PHPP) modelling and thermal, airtightness and overheating analysis. Inbuilt can also provide certification from the Passivhaus Institut for those buildings that fully comply with the PHPP criteria.

Walking the talk

The Inbuilt team is currently working on a range of Passivhaus projects from housing to schools and refurbishments.

2 ADVICE, CONSULTANCY AND CERTIFICATION

Trying to design a Passivhaus or need Passivhaus expertise on your team?

Inbuilt can help. Delivery of a Passivhaus relies on expertise from concept development through to construction. Inbuilt's consultants work with architects and contractors to ensure that the Passivhaus standard is met.

Our service can be tailored to your understanding and experience of Passivhaus design. We can:

- **Train your design team and contractors** in Passivhaus design principles and in the use of the PHPP.
- Provide clear and concise **Passivhaus guidance throughout the design process** based on the PHPP modeling of your project.
- **Check architectural details for airtightness,** and provide thermal modeling calculations to **ensure that all details are free from cold bridging**.
- **Provide on-site construction quality checks**, collect and document the evidence required for certification.
- **Provide verification and certification of the completed building**, leading to receipt of a Quality Approved Passivhaus Certificate from the Passivhaus Institut.

3 SPREADING THE WORD……

The solutions to energy security and climate change are too important not to share. Inbuilt can teach you how to design and build a Passivhaus and show you these important buildings at close quarters.

Passivhaus Design Tour

Inbuilt arranges bespoke study tours to visit Passivhaus buildings across Europe, so you can learn about Passivhaus first hand. Our tours optionally include workshops on Passivhaus design and use of the PHPP, an overnight stay in a Passivhaus, and study trips to Passivhaus new-build and renovated houses, schools, and offices. We even run 'fast track' day trips!

Passivhaus Training

Inbuilt offers tailored training in Passivhaus design and the use of PHPP for developers, architects, contractors and anyone interested in low-energy buildings.

4 TO FIND OUT MORE OR GET A QUOTE FOR OUR SERVICES PLEASE CONTACT:

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And visit our website: www.inbuilt.co.uk

Passivhaus is only one part of a sustainable building. Inbuilt offers holistic sustainable design and consultancy including Code for Sustainable Homes and BREEAM.