The passive concept

Never having to spend money on heating…

A passive building is so well insulated that a regular heating or cooling system is not required. The building must be airtight. Ventilation is controlled and the ventilation heat losses are dramatically reduced with heat recovery from the exhaust air.

A building's heating requirement depends on the thermal performance of its roof, walls, floor, windows and doors, and ventilation arrangements. In a passive building, the overall heat losses are reduced to such an extent that most of the heat required comes from the activities within the building, internal gains. The second largest contributor to heat is solar irrigation through windows. Only a small proportion of the heat needs to be purchased, and this energy can come from sustainable sources such as wind generated electricity.

Homes, offices, industrial buildings, schools, or any type of building can be built to passive standards. Differing climate conditions make reaching this goal harder. In northern Scandinavia with winter temperatures of -40°C this is a difficult task, but in all other European climate zones passive houses can easily be constructed.

The standard is a scientific definition of very low energy usage for buildings. The building's shape, materials used in its construction, or types of energy used is irrelevant for the standard. The German Passive House Institute defines a passive house primarily based on its calculated energy usage for space heating and water per m² living area measured in kWh/m²/yr. The requirements are: less than 15kWh/m²/yr annual space heat requirement and a primary energy consumption of less than 120kWh/m² including hot water and electricity. Another and simpler method is to use the peak heat demand on the coldest day of the year measured in W/m². The official Swedish definition of a passive house is measured this way; a constant heat of load of <10W/m² in the coldest design temperature. This unit is easier to understand and to measure.

Zero carbon buildings – an unrealistic target?

It is generally considered that there must be a balance between the amount of resources spent on a building and the amount of energy used to heat or cool a building over time. Passive houses are realistic and affordable to build. The zero carbon ambitions seem to be most popular in countries with historical low insulation standards. The official tendency in some countries to prioritise alternative ways of producing and controlling heat instead of reducing the energy consumption is problematic. The idea has been put forward that focuses on production of renewable energy rather than reduced energy usage originates from the powerful construction industry. The conventional industry has been caught off-guard for their unwillingness to improve construction methods for the last 30 years in many countries. The amount of thermal mass gathered inside the building envelope is of secondary value. Any passive house – regardless of construction method – demonstrates an extraordinary thermal stability without the specific use of extra masonry thermal mass. The arguments for large thermal mass seem to be put forward most often by the concrete industry. The idea of giving each country the flexibility to adapt the passive norm

Lars Pettersson passive house enthusiast and founder of Scandinavian Homes Ltd. Galway, Ireland

Passive wall complete with insulation and triple glazed windows ready to be shipped from Scandinavian Homes factory in Sweden to a site in Ireland

Passive house built in Galway, Ireland, by Scandinavian Homes Ltd. 250m² floor area and six bedrooms. A minimal heat requirement of <3watt per m² floor area in the mild Irish winters. Timber frame construction. Evaluated by Passiv Haus Institute programme PHPP

to local conditions has come up. However, this might not be ideal if the passive standard is open to compromise by political interests in countries with historically low construction standards.

Affordable passive houses

Never having to spend money on heating is a very attractive concept. To reach this very high level of performance one could expect that the building costs would increase sharply. This does not have to be the case. A cost-efficient approach to build passive houses must follow rules of simplicity. The designer of a house must be aware of the negative implications of complex architectural shapes. Some features might be culturally correct and fashionable – but be aware of their energy, and cost consequences. Dormers, roof windows, bay windows, long and narrow extensions to the main body, split levels, are examples of features that cost energy in practice.

Some general points about passive design:

- The building envelope: bulky and compact shape;
- The windows: performance and orientation to south, west and east;
- As few external doors as possible;
- One half of the roof in a south direction for solar collectors;
- Ventilation system: heat recovery with more than 80% thermal performance.

In a mild climate such as in Ireland it is possible to build affordable passive houses, as demonstrated by Irish company Scandinavian Homes Ltd in Galway. 30 individual houses are completed to passive standards using the Swedish standard building methods.

Example of construction of a passive house

A standard prefabricated timber frame house can be constructed to normal building costs with the following performance of components:

- Foundation: concrete raft with 280mm of polystyrene insulation and 120mm around the circumference;
- Walls: 215mm of rock wool in two layers, alternatively 335mm of insulation in three layers for larger and more demanding shapes of houses;
- Roof: 400-700mm of blown-in cellulose-fibre insulation;
- Windows: triple glazed with argon fill and low emission coatings;
- Airtight to 1.0 air exchange per hour at 50Pa pressure and without cold bridging;
- Simple whole house ventilation system with heat recovery 85% thermal efficiency.

For further information, please visit our website.

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