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PASSIVE HOUSING SYSTEM FOR SUSTAINABLE BUILDING

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ABSTRACT

Interest in new buildings is on the rise, and every new building is an investment in the future. After all, buildings last far more than a generation. Yet our children and grandchildren will inherit a world much different than ours, and the changes can already be seen: raw materials and energy will still be available, just not at today‘s prices. In addition, the polluter-pays principle will still apply. Take advantage of the efficiency of tomorrow today by building in compliance with the Passive House standard. A passive house is a building in which a comfortable interior climate can be maintained without the need for a conventional heating system such as boiler or geo-thermal heat pump. A small back-up heat source is all that is needed in very cold weather. A passive house is a cost-efficient building that can manage throughout the heating period, due to its specific construction design, with more than 10 times less heat energy than the same building designed to standards presently applicable across Europe. Its extended thermal insulation and enhanced air-tightness removes the need for higher temperatures. This makes renewable energy sources particularly suitable for heating and cooling. Passive solar heating is a well established concept in cold climates, but passive systems which provide heating, cooling and ventilation depending on the season. Some of the known systems in this category are: Sky-Therm, earth-air tunnel, the Silvestrini Bell, and the Barra–Costantini System, which are applicable in composite climates. Large areas of Central and Northern India have a composite climate, which includes hot-dry, hot-humid and cold climatic conditions. Thus the passive housing will make the building a sustainable for our future generation and for all climatic conditions.

INTRODUCTION

The term Passive house (Passivhaus in German) refers to the rigorous, Voluntary, Passivhaus standard for energy use in buildings. It results in ultra low energy building that require little energy for space heating. A similar standard, MINERGIE-P®, is used in Switzerland.

The first Passivhaus buildings were built in Darmstadt, Germany, in 1990, and occupied the following year. In September 1996 the Passivhaus-Institute was founded in Darmstadt to promote and control the standard. Since then more than 6,000 Passivhaus buildings have been constructed in Europe, most of them in Germany and Austria, with others in various countries world-wide. Despite the name, the standard is not confined only to houses. Several offices building, schools, kindergartens and a supermarket have also been constructed to the standard. Although it is mostly applied to new buildings, it has also been used for refurbishments.

THE STANDARD ADOPTED IN PASSIVE HOUSING

The dark colors on this thermo gram of a Passivhaus (right) show how little heat is escaping compared to a traditional building (left).

The Passivhaus standard requires that the building is within the following limits:

- The building must not use more than (≤) 15 kWh/m²a (4,755 Btu/ft²/yr) in heating energy

- The specific heat load for the heating source at design temperature must be less than 10 W/m²
- With the building pressurised to 50Pa by a blower door, the building must not leak more air than 0.6 times the house volume per hour (n50 ≤ 0.6/h).
- Total primary energy consumption (primary energy for heating, hot water and electricity) must not be more than 120 kWh/(m²a) (38,039 Btu/ft²/yr)

These standards are much higher than houses built to most normal building codes. for comparisons, see the international comparions section below.National partners within the 'consortium for the Promotion of European Passive Houses' (PEP) are thought to have some flexibility to adapt these limits locally.Space Heating Requirement. By achieving the Passivhaus standards, Passivhaus buildings are able to dispense with conventional heating systems. The ability to do this is the underlying Passivhaus buildings do include a system to provide low levels of supplemental space heating. This is normally distributed through the low-volume heat recovery ventilationsystem that is required to maintain air quality, rather than by a conventional hydronic or

high-volume forced-air heating system, as described in the space heating section below.

Construction Costs.

In Passivhaus buidings, the cost savings from dispensing with the conventional Heating system can be used to fund the upgrade of the building envelope and the heat recovery ventilation system. With careful design and increasing competition in the supply of the specifically designed Passivhaus building products, in Germany it is now possible to construct buildings for the same cost as those built to normal German buildingstandards, as was done with the Passivhaus apartments at Vauban, Freiburg.Evaluations have indicated that while it is technically possible, the costs of meeting the Passivhaus standard increase significantly when building in northern Scandinavia above 60° latitude.

Building for the future today

Interest in new buildings is on the rise, and every new building is an investment in the future. After all, buildings last far more than a generation. Yet our children and grandchildren will inherit a world much different than ours, and the changes can alreadybe seen: raw materials and energy will still be available, just not at today‘s prices. In addition, the polluter-pays principle will still apply. Those who can meet their needs with a low consumption of resources and little environmental impact can consider themselveslucky.

Efficiency is here today

Take advantage of the efficiency of tomorrow today by building in compliance with the Passive House standard. The materials, designs, planning methods and experience required are already available. Passive Houses are your guarantee of comfort in thefuture: by consuming less than a forth of the energy allowed by German law, you can enjoy this house in the long term without forgoing any creature comforts or living at the expense of others.

Efficiency that pays for itself today

Energy-efficient construction is not only easy to finance, but even begins to pay for itself from the very first day thanks to subsidies granted throughout Europe. Homeowners can thus enjoy the comfort of tomorrow at an affordable price by offsetting otherwise high energy expenses.

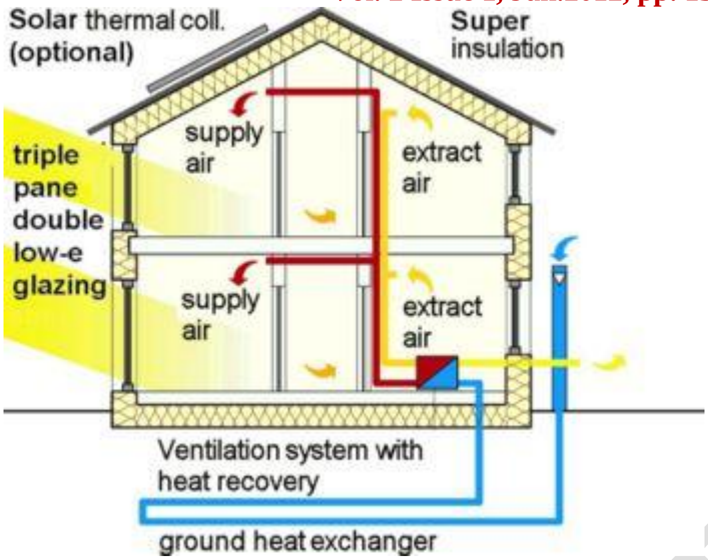
Efficiency through renovation

In Nuremberg, the „Modernization with Passive House Components“ campaign was launched starting with a demonstration project that drew global attention when it reduced the energy required to heat a typical complex of subsidized housing by 87 percent. In the meantime, the project has been copied numerous times. As always, the focus will be on practical implementation, construction experience and reviews of results. Beat escalating energy costs! Passive Houses allow for moreComfort and lower energy demand

• Manufactures of windows, doors, ventilation systems and insulating materials,

• Providers of building parts, construction systems, technical services installations and solar companies.

DESIGN AND CONSTRUCTION



The passivhaus uses a combination of low-energy building techniques and technologies.Achieving the major decrease in heating energy consumption required by the standard involves a shift in approach to building design and construction. Design is carried out
with the aid of the 'Passivhaus Planning Package', and uses specifically designed computer simulations.

PASSIVE SOLAR DESIGN

Following passive solar building design techniques, where possible buildings are compact in shape to reduce their surface area, with windows oriented towards the south (in the northern hemisphere) to maximise passive solar gain. However, the use of solar gain is secondary to minimising the overall energy requirements.

Passive houses can be constructed from dense or lightweight materials, but some internal thermal mass is normally incorporated to reduce summer peak temperatures, maintain stable winter temperatures, and prevent possible over-heating in spring or autumn before normal solar shading becomes effective.

SUPERINSULATION

Passivhaus buildings employ superinsulation to significantly reduce the heat leakage through the walls, roof and floor compared to conventional buildings. A wide range of thermal insulation materials can be used to provide the required high R-values (lowU-value, typically in the 0.10 to 0.15 W/m2K range). Special attention is given to
eliminating thermal bridges.A disadvantage resulting from the thickness of wall insulation required is that, unless the external dimensions of the building can be enlarged to compensate, the internal floor area of the building may be less compared to traditional construction. In Sweden, to achieve passive house standards, the insulation thickness would be 335 mm (0.10 W/m2C°) and the roof 500 mm (U-value 0.066 W/m2C°).

TYPICAL PASSIVHOUSE WINDOWS

To meet the requirements of the Passivhaus standard windows are manufactured with exceptionally high R-values (low U-values, typically 0.85 to 0.70 W/m²K for the entire window including the frame). These normally combine triple-pane insulated glazing (with a good solar heat-gain coefficient, low-emissivity coatings, argon or krypton gas fill, and 'warm edge' insulating glass spacers) with air-seals and specially developed thermally-broken window frames. In Central Europe, for unobstructed south-facing Passivhaus windows, the heat gains from the sun are, on average, greater than the heat losses, even in mid-winter

.

AIR TIGHTNESS

The standard requires the building to achieve very high levels of airtightness, much higher than are normally achieved in conventional construction. Air barriers, careful sealing of every construction joint in the building envelope, and sealing of all service penetrations through it are all used to achieve this. Airtightness minimises the amount of warm (or cool) air that can pass through the structure, enabling the mechanical ventilation system to recover the heat before discharging the air externally.

VENTILATION

Mechanical heat recovery ventilation systems, with a heat recovery rate of over 80% and high efficiency ECM motors, are employed to maintain air quality. Since the building is essentially airtight, the rate of air change can be optimised and carefully controlled at about 0.4 air-changes per hour. All ventilation ducts are insulated and sealed for air tightness.

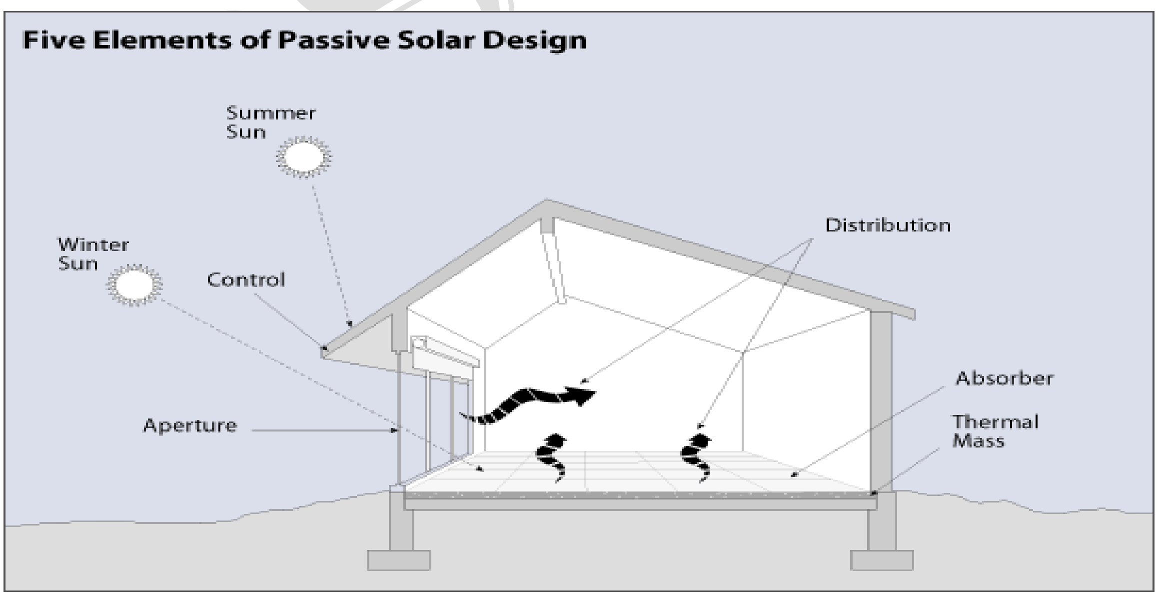
Although not compulsory, earth warming tubes (typically ≈20cm diameter, ≈40 m long at a depth of ≈1.5 m) are often buried in the soil to act as earth-to-air heat exchangers and pre-heat (or pre-cool) the intake air for the ventilation system. In cold weather the warmed air also prevents ice formation in the heat recovery system's heat exchanger.

PASSIVE DESIGN

Passive design is design that does not require mechanical heating or cooling. Homes that are passively designed take advantage of natural energy flows to maintain thermal comfort.Incorporating the principles of passive design in your home:

- Significantly improves comfort.
- Reduces or eliminates heating and cooling bills.
- Reduces greenhouse gas emissions from heating, cooling, mechanical ventilation and lighting.

Building envelope is a term used to describe the roof, walls, windows, floors and internal walls of a home. The envelope controls heat gain in summer and heat loss in winter.Its performance in modifying or filtering climatic extremes is greatly improved by passive design.Well designed envelopes maximise cooling air movement and exclude sun in summer. In winter, they trap and store heat from the sun and minimise heat loss to the external environment.The fundamental principles of passive design, explained above are relatively simple but they must be applied to a vast range of climates, house types and construction systems.



DESIGN FOR CLIMATE

This fact sheet provides a quick reference guide to the main climatic zones in Australia as well as the key passive design responses for each climate. It also explains the conditions required for human thermal comfort and how passive design assists our bodies in achieving comfort.

CHOOSING A SITE

Choosing an appropriate site, or existing home, and developing it to make the most of its natural attributes will yield significant economic, lifestyle and environmental benefits.The information is in three parts corresponding with the usual stages of choosing a site.Choosing a locality and housing type. Choosing a site, existing home or block. Choosing, designing or altering a home to suit your block.

CONCLUSION

- Implementation issues like financing, public acceptance, regulatory and cost should be considered.
- Many such design consideration with respect to the site condition is required.
- The cost of passive design elements can run the same or slightly more than normal building costs.
- The main function of the passive house is that it is suitable for all type of climatic condition.
- This building can also be called as a bio-climatic building.
- Even though the cost is very high when compared with that of the normal building the sustainability of the passive house is very high.

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