EC-LINK
中欧生态城
Europe-China Eco-Cities Link
中欧低碳生态城市合作项目

Performance Indicators

Green Buildings

Green building performance indicators

An indicator should provide information about the achievement of an indented result or quaiity – which on their own tend to be composed of many different factors and cannot easily measured in quantitative terms. However, certain performance characteristics can help to evaluate result and quality of en effort, ad to compare it with other competing ones.

In January 2015, China introduced its new ¨Green Building Evaluation Standard¨, replacing an earlier Green Building Evaluation Standard (GB 50378-2006) of 2006 (GBES). The current green building rating system uses a three star system which has some similarities with the LEED system of the US. [1]

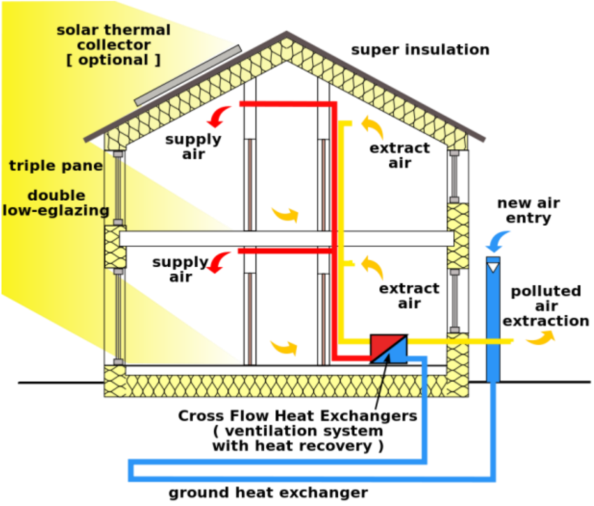
MoHURD´s green building evaluation standard is China´s first attempt to create a local green building standard. So far, the Three Star System lacks hard criteria for assessment. This has stimulated other methodologies for the assessment of building physics buildings. The purpose is to create a voluntary rating system that will encourage green construction. The purpose of introducing this green building concept is to regulate evaluation of green buildings. The system introduced in 2006 is credit-based and allows developers to choose which credits they want to pursue. The evaluation system has two different standards one for residential buildings and one for public buildings (i.e. large commercial complexes. The rating system will particularly rate those buildings or building complexes which consume much energy and resources.

The evaluation standard rates buildings with a variety or prerequisites (¨control items¨) and credits (¨general items¨), covering six categories: (i) land savings and outdoor environment; (ii) energy savings; (iii) water savings (iv) materials savings, (v) indoor environmental quality; and (vi) operations and management.

The_seventh category, ¨preferred items¨ contains strategies that are both cutting edge and harder to implement, such as brownfield redevelopment, more than 10% on-site renewable power generation, etc. [2]

By achieving the Passivhaus standards, qualified buildings are able to dispense with conventional heating systems. While this is an underlying objective of the Passivhaus standard, some type of heating will still be required and most Passivhaus buildings do include a system to provide supplemental space heating. This is normally distributed through the low-volume heat recovery ventilation system that is required to maintain air quality, rather than by a conventional hydronic or high-volume forced heating system.

Standard ¨Passivhaus¨[3]

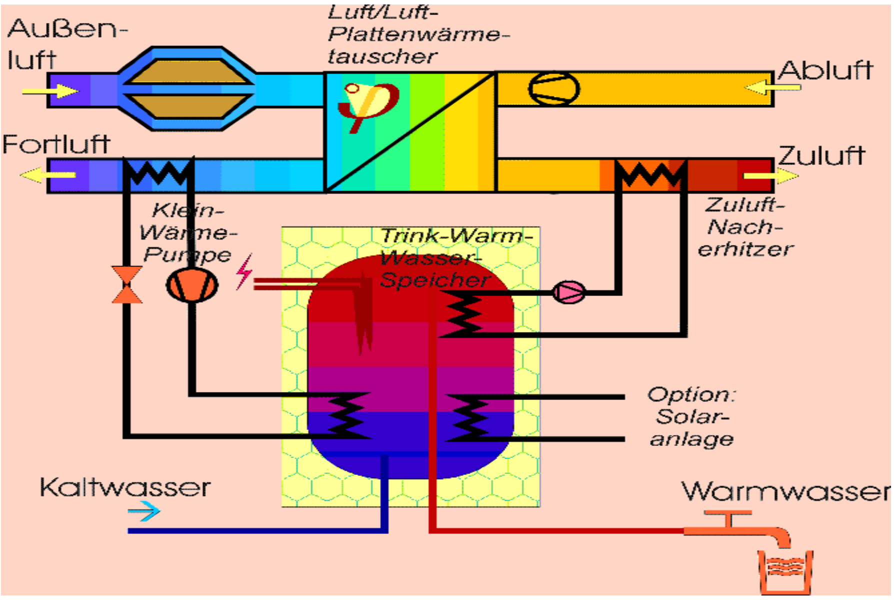


In Passivhaus buildings, the cost savings from dispensing with the conventional heating system can be used to fund the upgrade of the building envelope and the heat recovery ventilation system. With careful design and increasing competition in the supply of the specifically designed Passivhaus building products, in Germany it is now possible to construct buildings for the same cost as those built to normal German building standards.

On average passive houses are reported to be more expensive upfront than conventional buildings - 5% to 8% in Germany, 8% to 10% in UK, and 5% to 10% in USA.

Evaluations have indicated that while it is technically possible, the costs of meeting the Passivhaus standard increase significantly when building in Northern Europe above 60° latitude. European cities at approximately 60° include Helsinki in Finland and Bergen in Norway; Moscow is at 55°.

Example: Heat Exchanger



How the Heat Exchanger works:

In addition to the heat exchanger (centre), a micro-heat pump extracts heat from the exhaust air (left) and hot water heats the ventilation air (right). The ability to control building temperature using only the normal volume of ventilation air is fundamental

Source:
https://en.wikipedia.org/wiki/Passive_house

These facts have led a number of architects to construct buildings that use the ground under the building for massive heat storage to shift heat production from the winter to the summer. Some buildings can also shift cooling from the summer to the winter. At least one designer uses a passive thermosiphon carrying only air, so the process can be accomplished without expensive, unreliable machinery.¨[4]

Features:

Passive solar design and landscape.

Passive solar building design and energy-efficient landscaping support the Passive house energy conservation and can integrate them into a neighbourhood and environment. Following passive solar building techniques, where buildings are compact in shape to reduce their surface area, with principal windows oriented towards the equator - south in the northern hemisphere and north in the southern hemisphere - to maximize passive solar gains. However, the use of solar gain is secondary to minimizing the overall house 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 overheating in spring or autumn before the higher sun angle "shades" mid-day wall exposure and window penetration. Exterior wall color, when the surface allows choice, for reflection or absorption (Insulation) qualities depends on the predominant year-round ambient outdoor temperature. The use of deciduous trees and wall trellised or self-attaching vines can assist in climates not at the temperature extremes.

Superinsulation.

Passivhaus buildings employ superinsulation to significantly reduce the heat transfer 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. 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 (about 13 in) (0.10 $W/(m^2.K)$) and the roof 500 mm (about 20 in) (U-value 0.066 $W/(m^2.K)$).

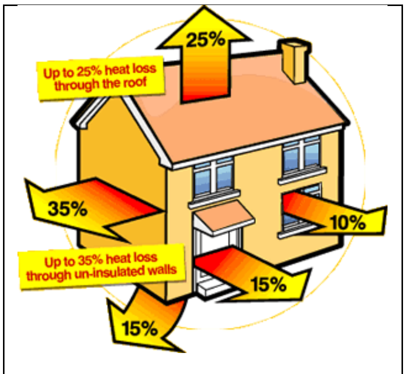
Advanced window technology.

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 $W/(m^2.K)$ for the entire window including the frame). These normally combine triple-pane insulated glazing (with a good solar heat-gain coefficient, low-emissivity coatings, sealed argon or krypton gas filled inter-pane voids, and 'warm edge' insulating glass spacers) with air-seals and specially developed thermally broken window frames.

Airtightness.

Building envelopes under the Passivhaus standard are required to be extremely airtight compared to conventional construction. In order to achieve these metrics, recommended best practice is to test the building air barrier enclosure with a blower door at mid-construction if possible.

Passive house is designed so that most of the air exchange with exterior is done by controlled ventilation through a heat-exchanger in order to minimize heat loss (or gain, depending on climate), so uncontrolled air leaks are best avoided. Another reason is the passive house standard makes extensive use of insulation which usually requires a careful management of moisture and dew points. This is achieved through air barriers, careful sealing of every construction joint in the building envelope, and sealing of all service penetrations.



http://www.corbwell.ie/res/heatloss.gif

Ventilation.

Use of passive natural ventilation is an integral component of passive house design where ambient temperature is conducive — either by singular or cross ventilation, by a simple opening or enhanced by the stack effect from smaller ingress with larger egress windows and/or clerestory-operable skylight.

Some Passivhaus builders promote the use of earth warming tubes. These are 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. Concerns about this technique have arisen in some climates due to problems with condensation and mold. Alternatively, an earth to air heat exchanger can use a liquid circuit instead of an air circuit, with a heat exchanger (battery) on the supply air.

Space heating.

In addition to using passive solar gain, Passivhaus buildings make extensive use of their intrinsic heat from internal sources—such as waste heat from lighting, white goods (major appliances) and other electrical devices (but not dedicated heaters)—as well as body heat from the people (Every person, on average, emits heat equivalent to 100 watts. Thus, a conventional central heating system is not necessary.

Instead, Passive houses sometimes have a dual purpose 800 to 1,500 watt heating and/or cooling element integrated with the supply air duct of the ventilation system, for use during the coldest days. It is fundamental to the design that all the heat required can be transported by the normal low air volume required for ventilation. The air-heating element can be heated by a small heat pump, by direct solar thermal energy, annualized geothermal solar, or simply by a natural gas or oil burner. A well-designed Passive house in the European climate should not need any supplemental heat source if the heating load is kept under 10W/m^2.

Because the heating capacity and the heating energy required by a passive house both are very low, the particular energy source selected has fewer financial implications than in a traditional building, although renewable energy sources are well suited to such low loads.

The Passive House Standards in Europe determine a Space Heating and cooling Energy Demand of 15 kilowatt hours per square meter of Treated Floor Area per year or 10 Watts per square meter peak demand. In addition, the total energy to be used in the building operations including heating, cooling, lighting, equipment, hot water, plug loads, etc. is limited to 120 kilowatt hours per square meter of Treated Floor Area per year (or in Imperial units 38.0 BTU/sf*yr.).[5]

Credentials;

Tool GB 1: Passive Energy Buildings.
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Copy edited by Kosta Mathéy, June 2018

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References

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[1] www.newwayswiki.org

[2] All of these seem still in their early stage as some of this conceptual work shows. Fu Qingpeng, Guo Li; Zhu Zhigang. 2011. Study on the evaluation of green building design based on the comprehensive fuzzy evaluation principles, in: *Electric Technology and Civil Engineering* (ICETCE), 2011 International Conference. Lushan. 22-24 April 2011.

[3] Source: www.passiv.de/en/01_passivehouseinstitute/01_passivehouseinstitute.htm

[4] Source: https://en.wikipedia.org/wiki/Passive_house

[5] https://en.wikipedia.org/wiki/Passive_house