THE SOLAR AKTIVHAUS – A BUILDING EXAMPLE

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Summary

On behalf of the solar power company 'Sonnenkraft' a new type of house was developed, that with the help of an active solar energy use reduces the environment pollution substantially and offers the potential to be a house that gives more energy than it takes.

Keywords: Solar Active House, Zero Energy House, Active Solare Use, heatpump, Photovoltaic, Solar Architecture, Daylightquality, Prefabrication

1 Previous history

Since 1999 the author was working together with the client 'Sonnenkraft'. Beside of this the VKR Group (to which belongs the company 'Familie' and the both companies 'Sonnenkraft' in St. Veit) occurred out of a Europe-wide survey, which showed, that solar building and the use of alternative energy has an extremely positive connotation. Since the products of VKR lie largely in the range of the use of daylight and alternative energy, the idea occurred, to build model houses, which are trend-setting. They accord to the standard of 2020, provide a high living quality and use the energy of sun. At the same time the author has a lot of positive experience with the concept of solar architecture, particular from the projects 'Gleisdorf' (an office building for the company AEE Intec and row houses) which were completed 1999 respectively 2000. In these buildings sixty percent of the energy gain was covered by solar energy. Their very positive performance data fall below the energy consumption of the passive house.

In the start-up phase for the development of the carinthian projects, the concept 'Solar ActiveHouse' was born, which emphasizes the increased application of solar technique. The building itself was developed and accomplished independently from the other model houses of the Europe-wide SolarActiveHouse program of the VKR Group. The following aims were set for the SolarActiveHouse:

2 Aims

In accordance with the high ethical claims of the new building owners the 'SolarActive House' idea works with aboveboard concepts, which don't pretend something, but are oriented towards highest effectiveness. The adequate attitude of this architecture relies on the fact, that out of the new thinking and techniques a new, independent architecture is to be developed, whose especial aesthetic values exist in good formal answers to the ecological questions.

This means, that in this concept neither 'new technique' is attached to old, traditional architecture nor the ecological questions are answered on a formalistic and superficial or even feigned manner. To satisfy this claim, the architecture of the single, respectively row

house again has been rethought in the initial phase to this project. Through countless variants an optimized basic concept was found. This concept has been developed by architect Reinberg together with the companies Sonnenkraft Österreich/ General Solar System, Solar Cap, AEE – Institute for sustainable Technologies (AEE Intec) and in the phase of accomplishment by the company 'Griffner Haus'. The pictures show the model house, which has been completed in summer 2009.

3 Building Concept

The building takes up a clear stance to the sun and indicates very directly the orientation to south and north. In the case under consideration the building openes fortunately towards a beautiful perspective to the south situated Alps. At greatest possible compactness the building optimizes the south face (as possible solar gain area).

For example: The chosen alignment (architecture) of the PV elements and the south glazing the building concept uses the changing stand of winter- and summer sun without having to move itself or it's elements: the winter sun reaches into the building and the direct summer sun is entirely absorbed by the PV elements.

The thermal solar collectors are integrated in the building because their function is increasing with the warmth of the surrounding. The number of collectors varies according to the requirements of the inhabitants and according to the location. In the case under consideration the solar radiation values are relatively good (Carinthia, 600m over sea level). It is constitutive at the development of this type of house, that it is not reducible to a mere technical concept which reduces energy limits. In this concept architecture itself is used to optimize the technical systems in a way, that their production can be used fully. Cost reduction in the building, altogether a better ecological balance. At the development of this building type it was paid attention that it can not only be used as single family house, but also as row house (compacted low rise building).

4 Building Equipment

The basis for the application of the building equipment is a very good building envelop to keep the loss of heat in winter as well as the loss of coolness in summer low. This building envelop represents almost the Passive House standard, but not in each detail with equally high claims. The building equipment uses exclusively proven products, which are unexpensive. The strategically applied technique components tend to an energetic all-season self-sufficiency of the building and a long term CO^2 neutrality.

Constitutive elements therefore are:

- The passive solar utilization is optimized in so far, that overheating can be avoided through good overheat control. So the usual limits for the passive solar utilisation (and therefore the daylight guidance) can be exceeded considerably. With this improvement of the winterly passive solar gains, the solar gains of the thermal collectors for the heating can be enhanced.
- Pre-assembled compact system: The system „Solar Compleet" is consisting of circa 25m² thermal collectors, one accumulator and a heat pump. Accumulator, heat pump and all faulty wiring elements are prefabricated and are delivered altogether in a box. Furthermore the window aeration is provided with a prefabricated switching system and the mechanical ventilation is delivered as compact application.

- Generation of electricity: 35-40m² standard PV elements are inserted with the aim to cover the annual power requirement of the building. The PV elements also make shadow in summer (double function).
- Controlled ventilation:
  a) Mechanical ventilation with recovery of air infiltration: a compact device with cross flow heat exchanger which is speed-controlled via CO^2 Sensor - or alternatively:
  b) Automatically controlled window-opener: the windows are opening and closing automatically depending on the concentration of CO_2 and the temperature of the internal and external air. This variant has been developed to reduce the aeration to the hygienic extent. Because the standard air change of the 0,4 or 0,5 fold at a useable living area of circa 150 m², a two-storeyed living room, only three or four inhabitants and a frequently absence of the whole family during the day or on weekend would cause an unnecessarily high rate of air exchange, it is due, that with this system of controlled window opening, considerable loss of energy (through too much aeration) can be avoided.
- The heating takes place through static radiators. They are integrated in the loam rendering as heating surface as well as in small areas as floor heating. Aligned to the solar heating the heat distribution takes place on a very low level and the spread between flow and return flow is only 8°. The radiators allow an individual choice of temperature for each room.
- The overheat control is effected through complete shading of the south façade by the PV elements and additional with exterior blinds, which are part of the window frame. The control of the blinds is bounded into the control system of the automatic window opening. Furthermore simple summer night ventilation is possible via the window controlling. There are windows for the discharged air on the highest point of the house in the north.
- Mood lighting via daylight: through the exterior blinds and the free control it is possible to chose the mood of the light in the building.
- A heat pump optimizes the different systems (thermal collectors, accumulator, earth collector) and uses the air as heat source. So it becomes possible to drive the solar cycle also under circumstances, where the temperature in the lowest area of the accumulator falls below the traditional limit. The sole can be preheated by the air-heat-exchanger before it enters the WP-evaporator. The efficiency of the thermal collectors is enhanced over circa 25 % („Solar Booster“).
- The fresh air supply (in the mechanical ventilation variant) is effected through a circa 35 m long earth-air channel (pre-cooling in summer respectively preheating in winter).
- Earth-tube collector: surplus from the thermal collectors is fed into an earth-tube (circa 150 linear meter sole cable as flat plate- or foundation trench collector below the building). It is used through a heat pump (‘energy-swing’). Thanks to an earth temperature which is increased a few degrees, times in which the heat sources are normally marginal, can be bridged without having to come back to a heating with electricity. Thereby an all-season solar handling shall become possible.
- Controlling: the whole controlling is effected through a central, energy saving computer.
- Dishwasher and washing machine are provided from the thermal (solar driven) accumulator, whereby a considerable saving of electricity can be gained.

- The optimized use of the daylight allows further considerable savings of energy.
- The supply with warm water is effected through a heat exchange principle, so that no warm water is stored. The water is heated by a 'flow-through system' so that the warm water is always fresh and hygienic clean (no problems with 'Legionella bacteria' are possible).
- The solar reserve of (available façade and room for collectors) allows an expansion of the system with new – in near future foreseeable – solar techniques as: thermal collectors for the cooling (a cooler unit, which works with absorption and dispenses the coolness over the wall areas, thermal collectors for the production of electricity, integration of weather forecast in the controlling system and so on).
- Prefabrication: the very high degree of prefabrication of all building equipment systems allows economical costs of production, a guaranteed error-free assembly and an optimal gain.

5 Materials

The building in the case under consideration has been built from prefabricated wooden wall elements (which have a thickness of circa 40 cm). These elements consist of a plasterboard construction, which is filled with pulp. Inside there is an additionnal insulation layer (5cm) which is also filled with pulp and which serves as running of cables. Inside the room this layer is closed with a plaster base for loam plaster (with integrated heating). In the north, east and west the outside walls are boarded with wood. The south façade is used either for the passive and active solar gains (by using solar windows which, in the heating period, gain more heat for the house than they loose), or they are covered with façade panels. These façade panels can be changed optionally through collectors. They can be adapted individually and therefore are open for other systems.

Fig. 1 Front of the SolarAktivHaus

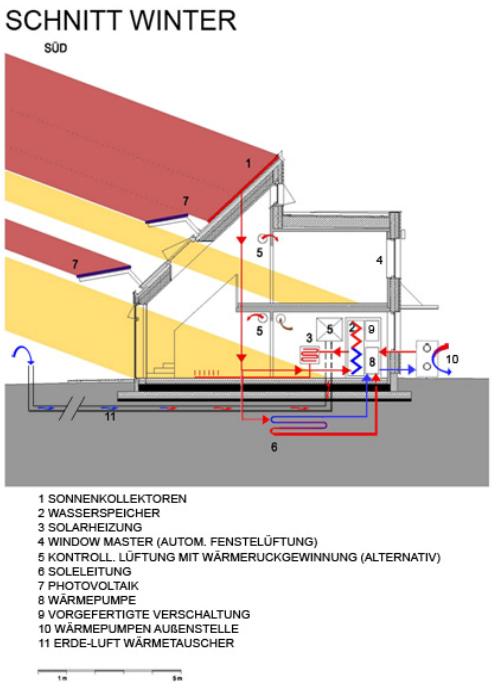

Fig. 2 Vertical section, winter

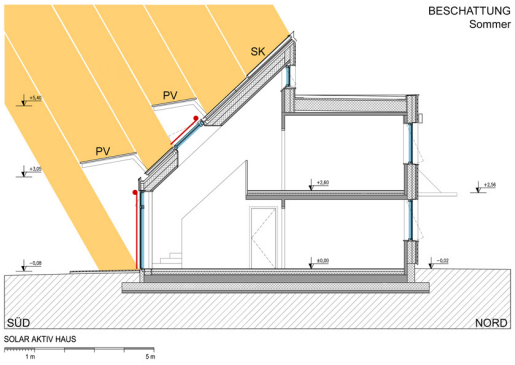

Fig. 3 Shading in summer

Fig. 4 Flying PV-Elements

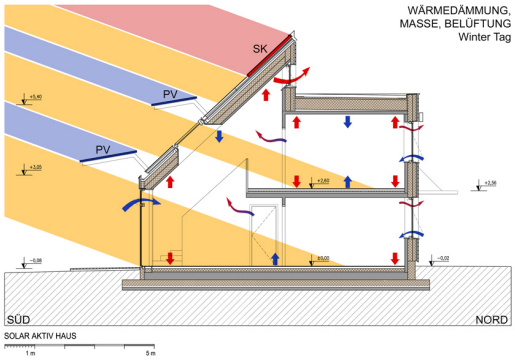

Fig. 5 Heat insulation, winter

Fig. 6 Sun in winter

Fig. 7 Frontsight in the night

Fig. 8 Gallery and roof fans

Fig. 9 Backwards, situated in the landscape