Lamparter passive office building

EnBau

The managing directors of the Hans Lamparter GbR engineering and surveying office in Weilheim an der Teck in southwestern Germany wanted to create a working environment for themselves and the employees that was first class in terms of both environmental friendliness and office environment. This goal was to be attained without generating additional costs as compared to conventional building practices. The office building was designed as an integrally planned passive office building with a heating requirement of less than 15 kWh/m^2 p.a. It is one of the first and smallest office buildings built in Germany based on the passive-house principle, and is characterised by its elegant building services equipment.

The Lamparter office building in Weilheim an der Teck was constructed without costing more than comparable buildings, and nonetheless achieves extremely favourable energy characteristic values combined with high comfort levels. The building as viewed from the southeast.
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Building summary

Project status	
Location	Bahnhofstr. 4, 73235 Weilheim a.d. Teck, Baden-Württemberg
Completion	12/1999
Inauguration	01/2000
Gross floor area	1.767 m^2
Heated net floor area	1.000 m^2
Gross volume	5.706 m^3
Work places	35
Usable floor area (according to EnEV)	1.370 m^2
A/V ratio	0,40 m^2/m^3
Key aspects	Heat insulation, Daylight planning, Ventilation + heat recovery, Regenerative + passive cooling, Heat / cold storage, Solar thermal energy, Photovoltaics

Project description

The plans for the office building were selected as part of a competition with invited entries, which was organised by the eventual building user, the Lamparter GbR engineering and surveying office. Adherence to “passive-house standards” was part of the competition specifications. The building site is located close to a former train station in the town of Weilheim. The building of two further office blocks is planned, as part of a second construction stage. There is room for around 30 employees in the 1,000 m^2 of net floor area.
Right from the beginning, the focus was on high energy standards, low costs and excellent user comfort. The architect consulted with a structural engineer and a specialist project planner on the technical building services equipment at an early stage in the design process. The principle of “integrated planning” was followed systematically throughout. Thermal simulation calculations were used to underpin planning decisions. The concept of passive cooling with overnight ventilation that was used raised fire-safety issues which lead to the retrofitting of a sprinkler system.

Building concept

The building has two long sides: one facing south onto a street, and the other facing north onto a garden. The top floor is set back a little on the street-facing side, thus fitting in better with the low buildings in the surroundings. The escape stairwell, which is located outside, is used to access the underground car park. The floor plan has rooms on both sides of the corridors. The office rooms face southwest and northeast, and there is a mixed zone in the middle with office equipment and a filing area. The top floor is suitable for multiple functions and is used for meetings and presentations. There are a small kitchen and toilet facilities on each floor in the northwestern corner, with a technical room in the top floor. There is one central, open stairwell in the interior of the building. The office building has a monopitch roof that opens to the south. The basic layout and the skeleton construction allow for a high degree of flexibility in the building: two-person offices, an open-plan office or group offices can be realised at any time.

Energy concept

The building was systematically planned as a passive house, right from the beginning. The passive-house concept aims to reduce transmission and ventilation heat losses in order to achieve lower heating requirements. Transmission heat losses are minimised by the compact building structure (A/V ratio of 0.4 1/m) and heat insulation that is between 24 and 35 cm thick. The windows use thermally insulating triple glazing. The deliberate east-west orientation of the building allows for passive solar energy use in winter. Ventilation heat losses are reduced by the airtight building envelope and mechanical ventilation that uses heat recovery and geothermal energy. The remaining heating energy requirement is supplied on a zonal basis using three backup heat exchangers included in the ventilation system. There are no radiators! The air is drawn through an earth-to-air heat exchanger and is preheated by a further heat exchanger that is alternately fed with supply air and exhaust air in turn. A small solar collector system is used in the provision of hot water. A gas-fired condensing boiler system is used to provide backup heating and the remaining heating requirement in the building. The earth-to-air heat exchanger is mainly used in cooling the building in summer. In the transitional periods, this exchanger can be bypassed in order to avoid unnecessarily heating or cooling the supply air to the building. In the case of summer cooling, a temperature reduction of 8-9 °C is expected; in winter, it is expected that the air will always be heated above the frost line.

The windows have a strip of skylights which are flush with the ceiling in order to allow natural daylight in. When combined with office depths adapted to suit the light situation and external sun protection with louvres that can be controlled separately in the skylight area, the offices can be used during the day with minimal need for additional artificial light. As well as providing for a pleasant working environment, this also minimises the amount of time that lights are switched on. The effective lighting system and daylight-based lighting control both contribute to lower electricity consumption for lighting.

The building is equipped with a small thermal solar system for hot water provision, and a photovoltaic system. The grid-connected solar power system on the roof and parapet provides around 6-7 MWh of electricity. This corresponds to around one third of the electricity consumption for artificial light and the ventilation system.

Performance

With a justifiable level of investment in construction and building services, the building has an annual heating requirement of around 12 kWh per m² of net floor area.

Over a longer period (here: the summer period from June until August), the heat gains and heat losses even themselves out. Heat storage in the components of the southwest offices accounts for 15% of this heat transfer, while the northeast offices are responsible for 10%.

The passive overnight ventilation approach to cooling the building is sufficient in “normal” summer weather conditions and leads to pleasant room temperatures with acceptable temperature peaks; the rooms in the upper and top floors are more problematic here than the ground floor is. However, designing the cooling capacity to deal with extreme weather conditions would lead to major overcapacity, which would not be viable (for the client) from a financial point of view.

Optimisation measures and possibilities

The energy consumption for 2003 was considerably less than in previous years, as the boiler for heating the building was now operated based on demand rather than on time, as before. Previously, the boiler was kept at a given target supply temperature (manual setting) for the whole of the heating period. Up until 2003, the exhaust fan of the ventilation system was also used in combination with overnight ventilation to cool the building during hot periods in summer. Overnight ventilation is now only based on thermal buoyancy and wind forces.

The measured data was useful in setting the control system. For example, it was detected that heating and overnight ventilation were actually working against one another. When the temperature in the offices in the morning was temporarily beneath the target temperature because of the effective overnight ventilation during hot periods, the heating was then switched on and supplied ‘unwelcome’ heat to the rooms. Once this was detected, it was easy to rectify.

Construction costs and economic viability

The specifications governing the competition entries placed the focus on the systematic integration of architecture, energy, comfort and costs at an early stage. The architects consulted with specialist project planners on the technical building services equipment at an early design stage. The fact that construction costs were kept below 1,000 euros/m² was due not least to effective project controlling on the part of the client. The solar thermal and solar power systems were integrated into the energy concept, as energy efficiency was a high priority in the project right from the beginning.

Key energy data

Energy indices according to German regulation EnEV (in kWh/m²a)	
Heating energy demand	11,60
Overall primary energy requirement	100,00
Measured energy consumption data (in kWh/m²a)	
Site energy for heating and domestic hot water (dhw)	17,80
Source energy for heating and domestic hot water (dhw)	19,00
Total source energy	124,60
Lighting	6,30
Ventilation	5,80

Implementation costs

Costs of implementation in €/m²	
Construction (KG 300)	823
Technical system (KG 400)	137

These figures represent estimated costs

Net construction costs (according to German DIN 276) relating to gross floor area (BGF, according to German DIN 277)

Operating costs

Costs of operation in €/m²a	
Heating	0,58
Total electricity consumption	2,12
Lighting	1,02
Infiltration/ventilation/cooling	0,94