Energon passive office building

EnBau

Visitors to the building's own website are greeted with a self-confident "Welcome to the future". The Software AG Foundation sees itself as the initiator of a real avant-garde project. With 8,000m², the world's largest office building planned in accordance with the passive house standard relies on a sophisticated ventilation concept, and is provided with heat and cold from renewable sources, namely from the ground, and from a remote heating system largely based on biomass. The building can meet the demands of the investor, and while providing high occupant comfort, also exhibits an architecture which attracts a great deal of attention.

A general vies of the Energon building. The towers in the front belong to the ventilation system.
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Building summary

Project status	
Location	Lise-Meitner-Straße 14, Ulm, Baden-Württemberg
Completion	10/2002
Building owner	Software AG Stiftung (+ Investor)
Gross floor area	8.266 m^2
Heated net floor area	6.911 m^2
Gross volume	32.223 m^3
main usable floor area	5.412 m^2
A/V ratio	0,22 m^2/m^3
Key aspects	Heat insulation, Facade systems, Glazing + windows, Atrium, Daylight planning, Ventilation + heat recovery, Regenerative + passive cooling, Photovoltaics

Project description

The building in Ulm (Germany) is at the head of a row of buildings in "Science Park II". As investor in the new office building, the Software AG Foundation also formulated ecological objectives for the property. For this office building, the passive house standard was called for in a limited-invitation competition for planning teams. High comfort and an up-market atmosphere with economical construction methods were additional requirements. In this construction project, the as-yet largest office building compliant with the passive house concept was built.

Building concept

The symmetrical, compact building structure with five storeys has a physically curved facade. A generous glass-covered atrium forms the centre of the building. Walkways and stairs, as well as open areas oriented towards the atrium on the individual storeys make the atrium a hub of communication. It also serves for ventilation, and for use of daylight. Due to strategic coordination of the fire protection and climate concept, it was not necessary to seal off the offices from the atrium.

The building is a reinforced concrete skeleton construction with facades made of prefabricated wooden elements of largely equal dimensions. 20cm-thick insulation material under the foundation slab, 35cm in the facade, up to 50cm in the roof, and thermally insulating triple glazing in thermally insulated frames contribute to a very high degree of insulation. As glass accounts for 44% of the building envelope, solar loads are kept low, and nevertheless, good use of daylight is guaranteed.

Energy concept

For heating and cooling, the building primarily uses concrete core temperature control. For the purposes of concrete core temperature control, plastic tube heat exchangers with a surface area of around 5,000m² are laid with 10cm clearance from the underside of the flooring. For temperature control, the 40 borehole heat exchangers protrude about 100m deep into the ground. Within them, water flows in a closed circuit that comprises the borehole heat exchangers and the tube heat exchangers. Thus, the ground functions as heat

storage or cold storage, and the bivalent utilisation supports thermal regeneration.
Due to large-scale activation, even very slight overtemperatures or undertemperatures are sufficient to heat or cool the very well insulated, energy-optimised building. In winter, the building's internal yields are often enough to ensure thermal comfort. If the water for the concrete core temperature control needs to be reheated, this occurs primarily via waste heat from the compression refrigeration machines for the server rooms and cold storage rooms for food. The remaining heat energy requirement is covered by remote heating.
The thermal inertia of the concrete core calls for a sophisticated control concept. To charge the concrete core optimally, the required pump running time is determined upon consideration of the room temperature, floor temperature, and water temperature. Individual room control is not possible. The concrete core temperature control is supplemented by a sophisticated ventilation concept: outdoor air is channelled through a 28m-long underground duct to the air supply centre, where it is further cooled (or heated, depending on the requirement) by the borehole heat exchangers. If heating is required, the heat recovered from exhaust air is used. In the event of very cold outdoor temperatures, the air can be further heated using remote heating. Spray humidification keeps the relative humidity of the supply air above 30% even in cold periods.
The conditioned supply air is then channelled into the atrium. From there, it flows through noise-insulated overflow openings in the atrium facades and through air ducts in the concrete ceilings to the exterior offices. If required, the atrium can be ventilated naturally via smoke and heat vents; all offices and lounges have windows which can be opened. Exhaust air is actively extracted by suction in the offices, and channelled to the central air exhaust on the roof.

Performance

Both the contractor and the occupant are highly satisfied with the building and the workplace comfort. Even during the inaugural phase, when the ventilation was not yet fully functional, and the heating was controlled manually, the tenants experienced hardly any utilisation restrictions.
In 2005, the final energy consumption for heating, ventilation, cooling and lighting, including building cooling and the cafeteria (without refrigeration devices) was very low at 47.2 kWh/m² p.a., and is well beneath the support initiative's required level. However, the heating consumption of 34.6 kWh/m² p.a. is still above the calculated requirement of 12 kWh/m² p.a.
In 2005, the primary energy consumption was 81 kWh/m² p.a.; if the energy fed from the building's own PV system is taken into account, this is reduced by another 5 kWh/m² p.a.

Optimisation measures and possibilities

In terms of energy, the building's performance will improve without additional measures as soon as the building is fully rented out. This is because empty rooms have meant that internal heat gain has as yet been missing in the energy balance. As the unused rooms were permanently shaded, the solar yields were also missing here. Why the room temperature was almost 3 kelvins too high during the 2005 observation period is yet to be explained.

Construction costs and profitability

The quality of the furnishing and the thermal comfort aid the investor in the attempt to attract tenants. In the tenancy agreement, an upper limit of €0.75/m² per month is guaranteed for ancillary costs incurred by heating, cooling and ventilation. However, at €12/m² per month, the rent is relatively high from a local perspective. Upon completion of the building at the end of 2002, there was a great deal of unoccupied office space in Ulm, so renting out was correspondingly difficult. In 2004, the proportion of rented floor area increased from an initial 31% to 60% at the end of the year. In 2006, it is 80%.

Key energy data

Energy indices according to German regulation EnEV (in kWh/m²a)	
Heating energy demand	12,00
Overall primary energy requirement	67,00
Measured energy consumption data (in kWh/m²a)	
Thermal heat consumption (in 2005, based on NGA)	21,70
Total source energy (in 2005, based on NGA)	81,00

Implementation costs

Costs of implementation in €/m²	
Construction (KG 300)	889

Technical system (KG 400)	327

These figures represent established 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	
Cost of operation	26,76
Heating, Cooling, Ventilation, Lighting	4,70

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