

International Solar Centre Berlin - A Comprehensive Energy Design

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Abstract

The International Solar Centre is a unique development in Berlin combining a historic building and contemporary architecture to create 22 200 m² of customised office workspace and the Berlin Energy Forum exhibition area, for companies and organisations active in the growth markets of renewable energy and energy efficient consumption. The building promotes a sustainable energy economy achieved through an innovative energy concept. The aim of the concept is to realize a low-energy standard, taking particular account of renewable and rational energy conversion technology.

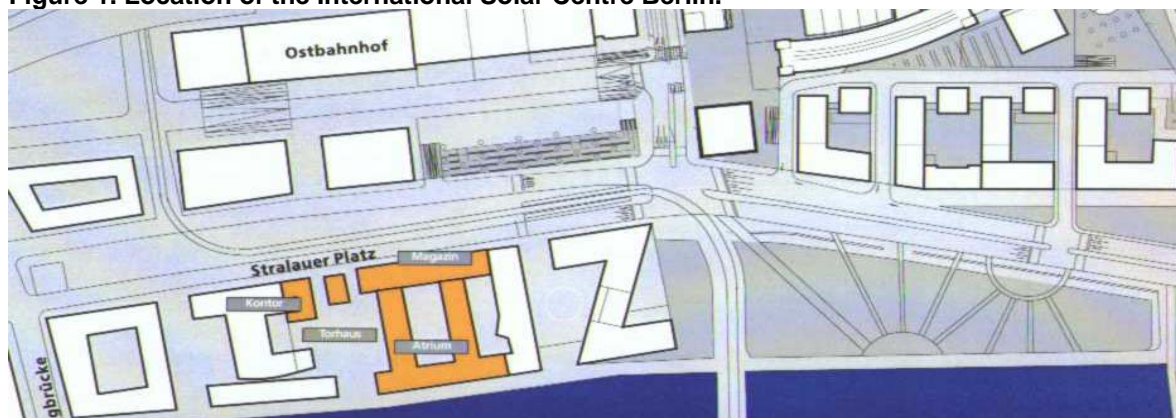
This concept comprises a high thermal insulation of facades and windows, innovative glazings and shading systems and a natural ventilation system during summertime. For the heating period an energy efficient mechanical ventilation system with heat recovery is activated. About 20 % of the heating demand and 100 % of the cooling demand is covered by a seasonal heat storage (200 energy piles) underneath the building which is combined with a heat pump and a concrete core heating and cooling system. Photovoltaic panels with an area of 500 m² and an electric peak power of 55 kW will produce an estimated 46 MWh per annum. A small fuel cell will demonstrate the possibilities of future domestic energy systems.

On the occasion of the 25th year's issue of the scientific journal *Bauphysik* published by Ernst & Sohn the International Solar Centre Berlin was awarded with the first place for its comprehensive energy design.

Building Description

The International Solar Centre Berlin (finished in summer 2003, 55 Mio. € investment costs) opposite of the Ostbahnhof joins a growing number of development projects in the immediate surrounding area called "MediaSpree", some of which are under construction or have already been realised.

Figure 1. Location of the International Solar Centre Berlin.



Source: Hanseatica 16. Grundbesitz Investitionsgesellschaft mbH & Co. KG

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The building is located on the Stralauer Platz in Berlin-Friedrichshain, and consists of a previously existing warehouse building, two newly built, L-shaped side wings and a glazed atrium, see Figure 2.

Figure 2. International Solar Centre Berlin.



Source: Hanseatica 16. Grundbesitz Investitionsgesellschaft mbH & Co. KG

The new part was designed by Bothe, Richter, Teherani architects, Hamburg. It has six stories with multifunctional office area and a variable floor plan. The warehouse was renovated as a historical monument by the Berlin architects Jentsch Architekten.

Table 1. Area balance of the building.

	East part [m ²]	West part [m ²]	Warehouse [m ²]	Total [m²]
Usable floor area	7 964	7 478	5 799	21 241

Energy Concept

The aim of the concept is to realize a low-energy standard with a primary energy demand of less than 100 kWh/(m²a), see Table 2. The characteristic energy values of the building comprise the heating demand and the electric demand for heating, cooling, ventilation and lighting. The energy consumption of the office equipment like computers, printers and photocopier is excluded.

Table 2. Characteristic energy values of the building.

Heating demand	≤ 40 kWh/(m ² a)
Total endenergy demand	≤ 70 kWh/(m ² a)
Primary energy demand	≤ 100 kWh/(m²a)

A further goal of the project is to visibly use energy technology components (photovoltaic, small fuel cell) which have just left the laboratory and reached the production or pilot production stage.

Building envelope

The surface to volume ratio of a building has a deciding influence on the heating demand. By closing the inner courtyard of the building with a high performance glazing a very good value of $0,15 \text{ m}^{-1}$ was reached. The atrium is heated to a temperature of 15 °C during wintertime.

The insulation layer of the building comprises the new building, the warehouse and the atrium. The insulation of the façade of the new building consists of 16 cm stone wool, the roof and the slab are insulated with 20 and 16 cm of extruded polystyrol. Because of preservation reasons the walls of the warehouse are insulated on the inside with 8 cm of stone wool.

The windows with an orientation to the east, west, south and the horizontal are glazed with a high performance glazing with a high insulation ($U_w = 1,1 \text{ W}/(\text{m}^2\text{K})$), a low solar energy transmission (34 %) and a high light transmission (68 %). To reduce cold bridge effects at the windows, the glazings are insulated with stainless steel spacers and the frames have a U-value of less than $2,0 \text{ W}/(\text{m}^2\text{K})$.

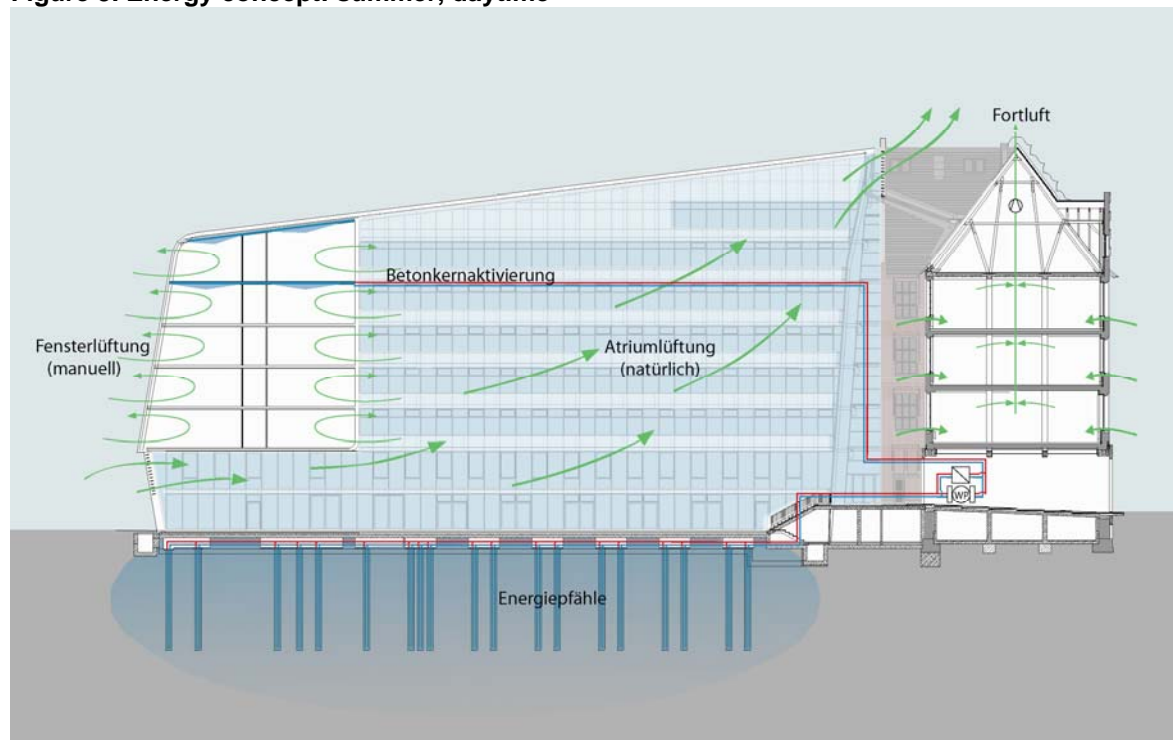
Building ventilation

During summertime a natural ventilation system which includes the 40.000 m^3 Atrium is used to provide the adjacent offices with fresh air and to automatically cool off the concrete ceilings at night, see Figure 3.

The atrium is naturally ventilated by two 50 m^2 openings with vertical louvres. The air inlet is located at a height of 3 m at the south end and the outlet is located at a height of 30 m at the north end of the atrium. The openings consist of a field of vertical louvres which are controlled by the building automation system.

Every second window of the new building is equipped with chain motors and controlled by a natural ventilation system. The windows are opened during nighttime depending on the wind speed, rain, the room and ambient temperature.

Figure 3. Energy concept: summer, daytime

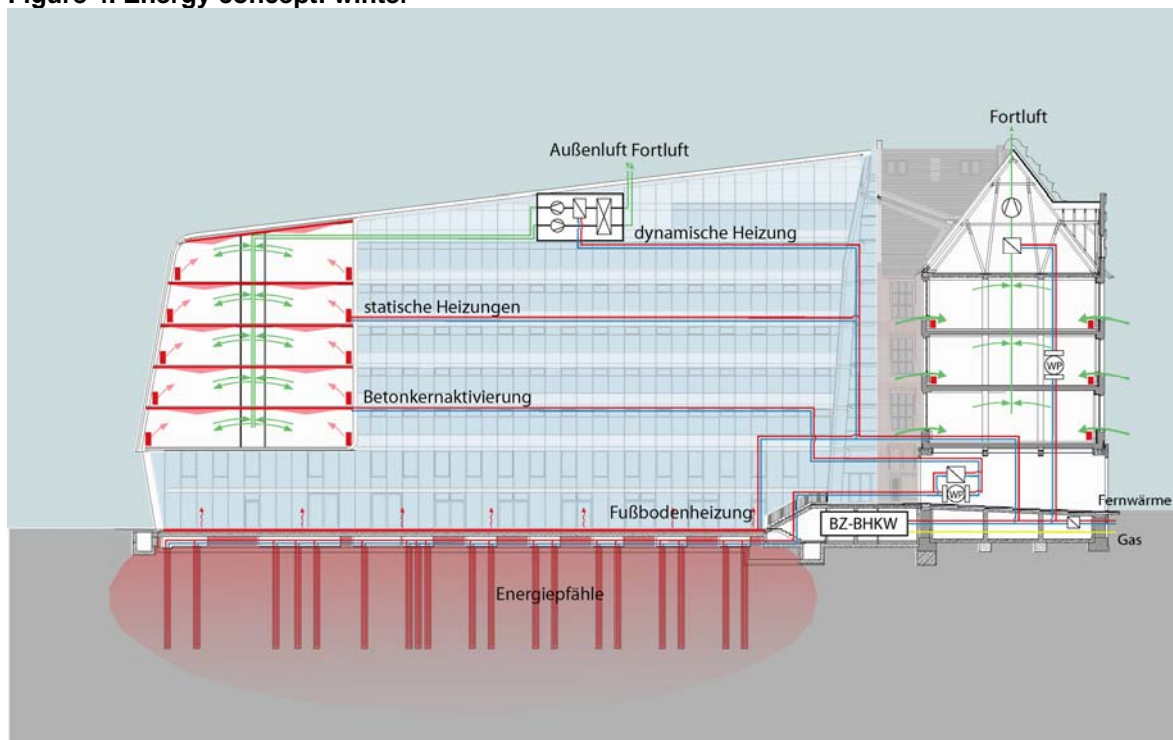


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For the heating period an energy efficient mechanical ventilation system with a heat recovery wheel (efficiency: 80 %) is activated in the new building, see figure 4.

Because of the sound emissions from the Stralauer Platz it is necessary to ventilate the warehouse with a mechanical ventilation system for the whole year. The preservation demands had also been taken into account. Only a simple exhaust ventilator in combination with sound insulated, passive air inlets can meet these requirements. To reduce the ventilation heat losses in the warehouse a heat pump obtains the energy provided in the exhaust air. In this way the ventilation heat losses are reduced by 25 %.

Figure 4. Energy concept: winter



Energy supply

About 20 % of the heating and 100 % of the cooling demand is covered by a seasonal heat storage (200 energy piles) underneath the building which is combined with a heat pump and the concrete core heating and cooling system of the building.

During the heating period the heat pump is used on the primary circuit side to extract thermal energy from the ground via energy piles, which is then raised to a higher temperature suitable for heating purposes. While the average temperature to be found in the concrete foundations is between 4 and 14 °C, the heat pump generates temperatures of 27 °, which is suitable for the concrete core cooling and heating system of the building.

In summertime the temperature level of the water which circulates through the energy piles is used via heat exchanger directly with a temperature of 18 °C in the concrete core cooling and heating system. The energy potential is increased as the ground is cooled further through heating with the heat pump in wintertime.

Photovoltaic panels with an area of 500 m² and an estimated electric power of 55 kW will produce around 46 MWh per annum. A small fuel cell will demonstrate the possibilities of future domestic energy systems, see table 3.

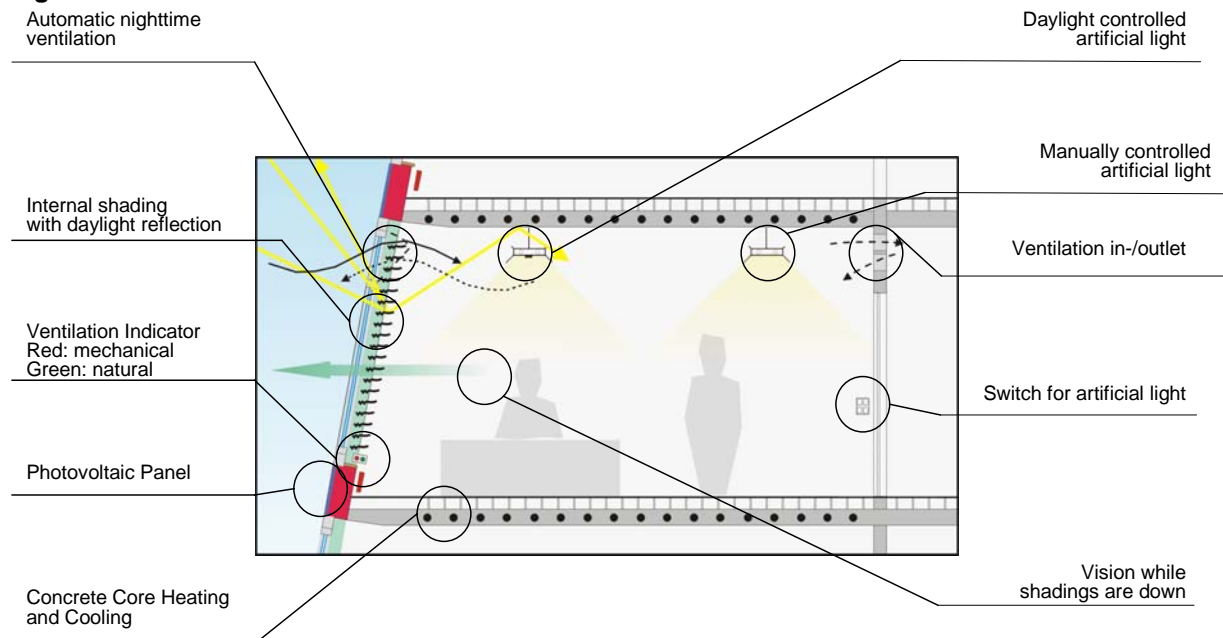
Table 3. Supply of energy of the building.

	Electricity [kW]	Heating [kW]	Cooling [kW]
District heating		885	
Heat pump (exhaust air)		46	
Heat pump (energy piles)		107	
Energy piles			150
Photovoltaic	55		
Fuel cell (planned)	5	7	

Office module

Figure 5 shows a section of an office module at the south façade of the building. The high performance glazing with a solar transmission of 34 % makes it possible to use an internal shading system with daylight reflection. The slats of the shading system have a special shape and a high reflective surface. Depending on the position of the sun, the shading system either reflects the sunbeams to the ambient (summertime) or in the office (wintertime), see figure 5.

Figure 5. Section of an office module



The glazings with a high visible light transmission in combination with the internal shading system with daylight reflection gives a great potential to save electric energy. This energy saving potential is used by a

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coordinated lighting concept. A light sensor dims the artificial lightings located close to the façade depending on the daylight. The artificial lighting in the corridors is controlled by a motion sensor.

It is possible to open the windows all year. An indicator at each window frame shows if the ventilation system with heat recovery is working (wintertime) or if it is recommendable to open the window to have a natural ventilation (summertime).

The user has a great influence on the different components of the energy concept. Therefore a manual of the building was given to each user. It describes the energy concept, the different operating elements and his influence on the thermal comfort and the energy consumption.

Monitoring

In order to pave the way for energy savings and utilizing solar energy in non residential buildings the Federal Ministry of Economics and Labour (BMWa) has established a support programme called "Solar Optimized Building", known as SolarBau. In subsection 3, SolarBau supports the planning and evaluation of demonstration projects. The Institute of Building and Solar Technology is member of the SolarBau team and is doing scientific monitoring in the International Solar Centre for the next two years. The main goals of the project are the detailed analysis of the energy demand of the building, the energetic efficiency of the renewable energy systems and the thermal comfort in the building.

References

Voss, Carsten, Günter Löhnert and Andreas Wagner. 2001. "SolarBau:Monitor, Energieeffizienz und Solarenergienutzung im Nichtwohnungsbau, Konzepte und Bauten". Freiburg.

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