Extension for KfW Bankengruppe

EnBau

The extension for KfW Bankengruppe is called the Ostarkade and is located in Frankfurt city centre near to the Palmengarten. KfW Bankengruppe, which is both the building developer and user, offers grants and low-interest loans for environmental protection measures. As such it is only appropriate that KfW pays attention to sustainability in its own buildings. In addition to energy optimisation for the heating, cooling, ventilation and lighting systems, a concept for saving water – a precious resource – was also developed for the new building. KfW put together a team of planners that was able to meet these challenges. Coordination of the planning process and cost control were assigned to a project controller. The building developers, represented by the project controller, the architects, the specialist planners and the energy planners engaged in active dialogue with each other from the outset.

The KfW Ostarkade from the south.
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Building summary

Project status	Optimized
Location	60325 Frankfurt, Hessen
Completion	2002
Inauguration	2002
Building owner	KfW Bankengruppe (+ Betreiber und Nutzer)
Gross floor area	17,402 m^2
Heated net floor area	8,585 m^2
Gross volume	67,052 m^3
Work places	350
Usable floor area (according to EnEV)	5,717 m^2
A/V ratio	0.25 m^2/m^3
Key aspects	Atrium, Daylight planning, Daylight systems, Optimised lighting, Ventilation + heat recovery, Regenerative + passive cooling, Thermo-active building element systems, Solar thermal energy, Biomass utilisation

Project description

At the start of the planning phase, KfW commissioned a study for an energy and sanitation concept that would keep the operational consumption of resources to a minimum. For all parties involved, the concept was agreed as a contractual basis for the subsequent building planning. In respect of energy efficiency, environmental protection and resource conservation, the integral planning resulted in simple, intelligent and sustainable solutions.

The new building for 350 employees is a perimeter block development that directly adjoins the KfW Nordarkade building. It is possible to move between the old and the new buildings on all floors. The main facade, which for noise reduction reasons is a double-skin facade, faces south onto Bockenheimer Landstrasse. To the north there is a view towards the Palmengarten.

Above the two-level underground car park, the building has five storeys of mainly offices and meeting rooms. On the fourth floor there are group offices for exchange traders, while the north-west part of the building is used for special purposes. Due to conditions imposed by the city of Frankfurt, 13 city apartments were built on the "roof" of the bank.

Offices and apartments are grouped around a horizontally glazed atrium. In addition to reducing the building's A/V ratio, this also allows natural lighting for the traffic zones which lead into the atrium. To make enough space available for a large conference hall on the ground floor, the atrium begins on the first floor.

Construction of the Ostarkade began in early 2001, and in autumn 2002, on schedule, the users began moving into the building one storey at a time. Employees were already using their workplaces on the bottom floor while the builders were still completing the user installations on the top floor.

Project context

The building shell is a reinforced concrete skeleton construction using in-situ concrete. The flexible floor plan, the facade grid and non-load-bearing lightweight partitions enable subsequent changes to the use of space. In the standard offices the concrete ceiling is exposed and merely surfaced with a thin layer of plaster. This thermal mass increases the building's thermal inertia and was essential for the passive cooling concept with night ventilation. Pipes, cables and ducts are laid in false floors.

The facade is externally insulated and provided with rear-ventilated natural stone panels as weather protection. Depending on the construction type, the external walls have a U-value between 0.24 and 0.5 W/m²K. The roof is a warm roof structure with foam-glass insulation. The roof areas are planted to a large extent. The compactness of the building and the high insulation standard minimise its transmission heat losses. With an average U-value of 0.54 W/m²K (facade including windows), the building exceeds the requirements of German Energy Saving Ordinance 2002 by approx. 30%.

A moderate percentage of glazing, an exterior automatic shading system and the use of solar control glass reduce the possible heat influx from outside. The lintel-free windows, light-diverting blinds and the proximity of workplaces to the window enable good use of daylight, thereby reducing from the outset the amount of electricity required for artificial lighting. The insulating glazing that is used has a g-value of less than 40%, a U-value of 1.5 W/m²K and 70% light transmission.

Energy concept

Key features of the energy concept are the predominantly natural ventilation of the building and the passive cooling system in the building. All workplaces that are not exposed to excessive noise have natural ventilation via windows. In summer, natural ventilation via the atrium cools the exposed concrete slabs. To achieve this, the skylights in the facade and the office/corridor partition walls are automatically opened. Due to natural uplift, the warm air escapes via a central shaft in the atrium and cooler outdoor air flows into the offices. The air change rates on the different storeys can be adjusted to each other by varying the degree to which the motor-operated skylights between the offices and corridors are opened.

Only the meeting rooms, the offices to the south behind the double-skin facade, offices with suspended ceilings and a number of special purpose areas are actively cooled. In summer, the supply air for the meeting rooms is precooled via indirect adiabatic cooling. The cooling is provided by a compression refrigeration machine. In accordance with the concept, part of the cooling energy for the cooling ceilings is to be obtained via a heat exchanger in the fresh water supply line that takes cooling energy from the drinking water. Where larger ventilation systems are needed for hygienic air change, heat recovery systems reduce the ventilation heat losses.

According to the planning, the building is heated using approximately 90% renewable energy sources. A wood pellet boiler was chosen, which for such a large building was a very innovative approach for the time. A condensing gas boiler covers peak loads. A 66 m² evacuated tube collector system heats drinking water for the apartments and the boardroom kitchen and supports the underfloor heating in the apartments. The hot water in the WCs and cleaning supplies rooms is generated decentrally via electric continuous-flow heaters.

To reduce thermal loads, even at that time all workplaces were equipped with TFT screens. The need for artificial lighting is minimised by a control system that is based on presence and daylight sensors and daylight-diverting sun protection blinds. A specially developed ceiling panel with four fluorescent lamps and electronic, dimmable ballasts is installed in each axis. The panel has a sound-absorbing surface that improves indoor acoustics and it can also be used for active cooling with a simple conversion. In order to reduce drinking water consumption, the grey water from the washbasins is treated in a microfiltration system and used to flush the vacuum toilets. No construction materials containing PVC were used anywhere in the building.

Performance

The Ostarkade is a building that combines a high standard with occupant comfort. The natural ventilation of the offices and the overnight cooling concept have proven themselves in practice. Even in 2003, the hottest summer in a hundred years, comfortable conditions were maintained in rooms without mechanical ventilation or active cooling. This required appropriate window ventilation and the correct use of the sun protection.

The good level of daylight and the control system achieved the low energy consumption for artificial light that was aimed for. However, the effect of the recirculating cooler that was provided for the building was underestimated in the concept phase. For example, the system for the uninterruptible power supply with its high heat emission resulted in constantly high electricity and cooling energy consumption for the recirculating coolers that are located there. By positioning the room at the edge of the building it would have been possible to simplify the dissipation of the thermal loads via an exhaust air system and thereby reduce the cooling load. Otherwise the causes of increased energy consumption were rarely design errors but rather modified

implementations in the construction process or control systems for operating installations that deviated from the concept. For example, the heating energy requirement increased as a result of heating the atrium and the supply air for the underground car park, neither of which was provided in the planning, and the average temperature of the offices was increased by 2 Kelvin.
Particularly in the first two years of monitoring, control processes were identified in certain systems that if anything worked against the actual goal of saving energy. The ventilation systems were in operation too often and for too long, while pumps for heating circuits were still running in summer. The target temperatures for the recirculating coolers were set too low, with the result that these operated continuously, requiring large amounts of cooling energy. Often the reason for mistakes of this sort was that the contractors implemented standard controls, contrary to the specialist planners' specifications.
Primary energy consumption for heating, ventilation, cooling and lighting was reduced continuously in the three measurement periods. The fact that the planned fresh water cooling system was not implemented until summer 2006 left a large potential saving untapped.
If the consumption for the building control equipment and the IT and technology recirculating coolers is not counted, the primary energy characteristic value in the third year is less than 100 kWh/m² p.a. The final forecast from the energy planners before construction began was 107 kWh/m² p.a. Thus the energy consumption is well below that of conventional office buildings.

Optimisation measures and possibilities

The fact that KfW fulfilled the combined roles of building developer and user, and at the same time was resolute that the operation of its buildings should be resource-efficient, had a very positive impact on the project. The interim results of monitoring were discussed at regular meetings with the building developer, the operators, the energy controllers and KfW's environmental department, even if the implementation of measures that had been decided on could not always happen immediately.
In the case of the recirculating coolers in the server rooms and technical rooms, conversion measures and adjustments to the control system resulted in considerable savings. As a result of these measures, the electricity consumption of the corresponding fans also fell sharply. The high power consumption of the cold water and cooling water pumps in the cooling distribution circuit was reduced dramatically via a demand-dependent control system.
It was found that the compression refrigeration machine was cooling with relatively low efficiency because the chiller is overdimensioned for the output that is required. As a result of difficulties with the wood pellet boiler, which had to be completely shut down at times, the proportion of the fossil fuel gas that was used increased. As of 2006, the cooling, heating and electricity generating systems for the property as a whole have been connected together in a network. With the aid of an intelligent load management system, it has been possible to compensate for these problems and run the installations more efficiently.
In the medium term a higher-level control system is planned for the entire Frankfurt property that will enable the continuous calculation of key energy data and the optimisation of the operation of all buildings.

Construction costs and economic viability

Corresponding to the high building standards and levels of user comfort, the construction costs are towards the upper end of the EnOB model projects.

Key energy data

Energy indices according to German regulation EnEV (in kWh/m²a)	
Overall primary energy requirement	107.00
Measured energy consumption data (in kWh/m²a)	
Site energy for heating and domestic hot water (dhw)	90.00
Source energy for heating and domestic hot water (dhw)	47.00
Total source energy	155.00
Energy lightign	10.00
Energy ventilation	3.00
Energy building services	4.00
Energy hot water supply	0.00
Energy cooling server-room	9.00
Energy cooling server-room	

Energy cooling server-room (assisting energy)	2.00
Energy cooling	2.00
Energy cooling (assisting energy)	3.00

Implementation costs

Costs of implementation in €/m²	
Construction (KG 300)	1,290
Technical system (KG 400)	572

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

Project description KfW Ostarkade Frankfurt
Information Website

This project is funded within the framework »Energy Optimized Building« (EnOB) by the German Federal Ministry of Economics and Technology, on the basis of a decision by the German Bundestag. Get further information at www.enob.info.