Children’s day care centre in Wismar

EnSan

This project demonstrates the metamorphosis of a dreary precast concrete building into a stimulating environment for our little ones. The children’s day care centre in Wismar was in urgent need of refurbishment. In this project, solutions were developed that offer significant architectural and usage-related improvements as well as energy efficiency improvements. To achieve this, the zone between the two main buildings, which are precast concrete structures, was enclosed completely transparently. While the exterior surface was only increased slightly, a huge increase of usable floor area was achieved. The unheated central area functions as a thermal buffer zone and the existing facades that face into it can remain uninsulated. Of particular structural interest are the transparent membrane roof over the new atrium, and the large-scale exterior wall insulation using vacuum insulation panels (VIP). With insulating glazed windows being additionally fitted level with the new external insulation, the windows which had been replaced previously could be retained. The energy concept includes controlled ventilation, zoned lighting, a heat pump, a solar thermal system and a photovoltaic system.

A thermal insulation composite system with vacuum insulation panels was installed on the western end wall facade.
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Building summary

Project status	Evaluated
Location	Zanderstraße 2, 23966 Wismar, Mecklenburg-Vorpommern
Year of construction	2005
Refurbished	2005
Building owner	Hansestadt Wismar
Occupant	Kinderwelt Wismar e.V.
Gross floor area	2,225 m^2
Heated net floor area	1,877 m^2
Gross volume	8,850 m^3
Work places	33
A/V ratio after refurbishment	0.42 m^2/m^3
Key aspects	Facade systems, Heat insulation, Atrium, Optimised lighting, Ventilation + heat recovery, Photovoltaics

Project description

The initial situation for the children’s day care centre was typical for a municipally owned precast concrete building: previously, the only work which had been performed was the repair work necessary for maintaining operation. But the city of Wismar wanted to keep the building in operation due to the favourable site plan. In the meantime, however, refurbishment had become essential – and not just for reasons of substance preservation and aesthetics. The thermal insulation, ventilation system and heating concept were outdated and inappropriate. At the same time, there were complaints about the limited usage possibilities and the lack of an overview at the children’s day care centre.
Integrated solutions were developed for the refurbishment that yield improvements in terms of energy efficiency, architecture and the use of the building. This results not only in reduced operating costs, but also in an increased “market value” for the facility – two economic advantages. Due to the system-built method, the concept that was developed can be transferred to more than 300 buildings of the same type which exist in the country.
Implementation of these measures took about a year. During this period, the services usually provided by the children’s day care centre were relocated. The building has been back in operation since February 2005.

Refurbishment concept

The building consists of two main buildings which were originally linked via narrow access buildings between them. After these adjacent areas were cleared, an atrium that is enclosed on all sides means that the space between the two parts of the building can be used not only for access but also as a social space or as a play area that is protected from the weather. This central area is not heated and therefore functions as a thermal buffer zone, which reduces transmission heat losses and ventilation heat losses. There was no need to refurbish the facades which face this atrium, and the heat storage capacity of these facades remains intact. In addition to serving as a design element, their new wood panelling also shades the walls in summer and improves the acoustics in the play area. The atrium's roof construction, which is made from membrane cushions, is installed with a steel support structure which stands freely between the existing parts of the building. The atrium can be shaded by adjusting the air pressure in the membranes.

For insulation on the existing end walls, vacuum insulation panels (VIP) are installed, which due to the limited thickness of their material, and due to their low specific weight, can be conveniently attached to the existing facades. Here, two different systems are being tried and compared: a thermal insulation composite system was realised with VIPs on the west facade, while a prefabricated VIP facade element was newly developed for the east facade.

The other exterior walls, which exhibited numerous leaks and thermal bridges at the window frames and at the wall panel joints, were conventionally insulated and covered with wooden panelling. For insulation, cellulose was blown into the cavities in the cold roofs from outside. A second window layer further out from the first layer improves the thermal characteristics of the plastic-framed windows which were only fitted in 1995. The double window effect increases solar yields in spring, autumn and winter.

A photovoltaic system is installed as protection from the sun above the windows on the southern facade. Part of this system is mounted fixedly, and part is mounted on a single-axis tracking system.

Energy concept

A new gas condensing boiler with adjusted output supplies two heating circuits for the north and south buildings and one for incorporation of a buffer storage tank. The old cast-iron radiators and convector radiators were replaced by panel radiators and compact radiators with thermostatic valves. Due to the good external wall insulation, it was also possible to locate the large low-temperature heating surfaces on the building's transverse interior walls, thus enabling the pipes to be grouped together.

A combined solar power system with a stratified combined storage tank serves to provide hot water for the kitchen and heating support. The hot water needed in the group rooms is heated by one heat pump per building section, in a storage tank. In the north wing, this is also connected to the buffer storage tank, while in the south wing the system operates monovalently.

A mechanical exhaust air system was installed for ventilation of the group rooms. The supply air is preheated in the naturally ventilated atrium and flows in through air supply elements which are integrated into the group rooms' window frames. Here, the air intake control, regulated by moisture sensors, reacts to the varying levels of occupancy in the rooms. The exhaust air is extracted by suction in the damp rooms and, with the aid of heat pumps, its heat is utilised for domestic water heating in the group rooms.

Numerous integrated, controlled opening casements in the atrium's long facades and end wall facades enable the air there to be changed up to five times an hour. In addition, the double leaf doors in the end walls can also be opened. In winter, the windows are opened only briefly for cross-ventilation, and overnight ventilation is deactivated or reduced to a minimum. In summer, the ventilation system is operated during the day, as long as the temperature in the atrium is below that of the outdoor air. Night ventilation of the atrium makes the building take longer to heat up during the day.

Linear luminaires and wall-mounted lamps for indirect lighting were installed in the group rooms. The wiring system enables three different lighting situations, according to requirements. At the same time, the lighting is adjusted to the exterior lighting with dimmable ballasts. A light sensor for all lights in a room guarantees a minimum light level. The adjoining rooms, such as sanitary rooms, cloakrooms and corridors, were equipped with linear luminaires, controlled via motion detectors, with electronic ballasts. The atrium is lit in a localised manner by 8 metal halide lamps at a height of approximately 6 m.

Performance

The Plappersnut children's day care centre has become a model facility in Wismar. As a result of improving the air and temperature quality, the level of sickness among children and staff has fallen considerably.

The building's final energy consumption is approximately 65% lower after the refurbishment. In particular the ventilation heat losses have been greatly reduced as a result of reducing the volume of heated air and preheating the air in the atrium. The measured air change rate of 0.31 or 0.25 per hour after the refurbishment does further reduce the ventilation energy losses, but it is lower than the air renewal standard of 0.55 per hour. An examination of the hygiene conditions showed that the CO2 level reached its highest value of 1,200 ppm after the children's midday nap, and subsequently fell off again sharply.

Optimisation measures and possibilities

The system of controlling the lighting via motion detectors did not prove successful in practice. The service life of the lamps is too short as a result of frequently switching on and off.

Construction costs and economic viability

The refurbishment of the building was urgently needed in any case. By involving the user in the planning process at an early stage, it was possible to combine the improvement of energy efficiency with the implementation of a new room concept and a design enhancement. The latest figures show that the operating costs are approximately 32,500 euros per year lower than before the refurbishment.

Award

The building was awarded the Bauphysikpreis 2005 (construction physics prize), and a commendation at the Mecklenburg-Western Pomerania Landesbaupreis 2006 (state construction prize ceremony).

Key energy data

Energy indices according to German regulation EnEV (in kWh/m²a)	before refurbishment	after refurbishment
Heating energy demand		85.52
Overall primary energy requirement		138.06
Measured energy consumption data (in kWh/m²a)	before refurbishment	after refurbishment
Site energy for heating and domestic hot water (dhw)	250.00	86.35
Source energy for heating and domestic hot water (dhw)		94.98
Total source energy		143.90

Implementation costs

Implementation costs in €/m²	
Construction (KG 300)	453
Technical system (KG 400)	172

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

Operating costs in €/m²a	before refurbishment	after refurbishment
Total energy costs		9.92
Heating and domestic hot water		6.11
Total electricity consumption		3.81

Projektinfo by BINE Information Service

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