

Comprehensive refurbishment of a school listed as a historic monument



A model project for the research topic of “Energy-efficient schools”: The school in Olbersdorf provides an example of a successful compromise between historic conservation and energy-based refurbishment. In order that the building, which was constructed in 1928, could also be used in future as a school, it was necessary to considerably reduce the energy costs. The most important starting point was to provide consistent thermal protection for the building. The building is a four-storey masonry structure with a gable roof. In future, 180 school pupils will be taught in 22 classrooms across a total usable area of around 4,900 m². The refurbishment will achieve the 3-litre house standard. Further developing the thermal insulation composite system using stepped profiles and adhesive technology prevents damage to the original facade and avoids isolated or linear thermal bridges. The new energy concept reactivates existing ventilation and lighting systems.



The school in Olbersdorf before refurbishment: Once refurbished, the building from the Weimar period is intended to achieve the so-called 3-litre house standard.

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Building summary

Project status	<div style="width: 10%; background-color: #0070C0; height: 10px; display: inline-block;"></div> Projected
Location	Schulweg 13, 02785 Olbersdorf, Sachsen
Year of construction	1927/28
Refurbished	2010
Building owner	Landkreis Löbau/Zittau, Landratsamt
Gross floor area	5,610 m ²
Heated net floor area	3,716 m ²
Gross volume	16,756 m ³
A/V ratio before refurbishment	0.29 m ² /m ³
A/V ratio after refurbishment	0.29 m ² /m ³
Key aspects	Facade systems, Glazing + windows, Daylight systems, Optimised lighting, Ventilation + heat recovery, Active cooling, Regenerative + passive cooling

Project description

With its main building and sports hall from the Weimar period, the school provides an important example of a regional school building from this period and is classified as a cultural monument according to the monument conservation act of Saxony. In recent years it has housed a secondary school. Görlitz district, which is the local school authority, is now looking to move the special school located in Zittau to Olbersdorf.

Refurbishment concept

The Olbersdorf school building is a four-storey masonry structure with a gable roof. The main entrance from the street is on the ground floor. Because the building is constructed on a slope, the rear entrance from the schoolyard leads into the first floor. Large parts of the building are constructed with a solid masonry structure that has a depth of 48 cm and achieves a U-value of around 1.25 W/m²K. In order to encourage a “learning atmosphere”, the refurbishment measures also intend to improve the acoustics and air hygiene, while lowering the indoor temperatures in summer.

In terms of the building fabric, the focus is on improving the thermal insulation of the building envelope in accordance with listed building requirements. Double windows were originally installed in the building. During the course of earlier refurbishment measures, the outer panes on the street side were replaced with double-glazed insulating glass and the inner panes of the double windows were removed. The original windows still remain on the courtyard side.

Energy concept

The refurbishment is intended to reduce the heating requirement by more than 80%. In addition to the structural improvements, these savings will be principally achieved by deploying modern heating technology and efficient

ventilation strategies, whereby low-maintenance technology shall be used that is appropriate for everyday use in schools.

Before the refurbishment, the heat was provided with a gas boiler. Ventilation was provided via the windows and exhaust air ducts integrated into the masonry structure, which are typical for the type of construction used when the building was built. These exhaust air ducts were only full functioning in the entrance areas and partly in the toilets, whereas in the classrooms they had been mostly blocked off during previous renovation work.

Daylight is provided in the teaching spaces by means of windows along one side of the classrooms, on either the west or east sides. Because of the building's position on a slope, the corridor spaces, entrance area and assembly hall receive too little daylight and require artificial lighting throughout the day.

As part of the energy-based refurbishment, a ground-coupled gas absorption heat pump is being installed, with peak load compensation provided by the gas boiler. The use of the ground as an energy source for the heat pump system is being provided as part of a comprehensive redesign of the open spaces to the east of the main building.

In the sanitary spaces, a conventional central exhaust air system is being installed with presence control. For the teaching spaces, customised ventilation is being developed that is substantially based on natural uplift and is only boosted with fans with low electrical consumption as appropriate ("hybrid ventilation"). For this purpose, the existing double windows and the partly replaced windows are being rebuilt with thermal insulation glazing installed in double air-supply windows. Via an opening in the lower frame, the external air enters the cavity between the panes, warms up and enters the room via the upper window frame. Because the air is pre-heated and supplied above the occupancy zone, this considerably reduces the risk of draughts. In order to prevent unwanted air currents, additional wind pressure reducers and check flaps are integrated in the windows. As soon as a specific external temperature is exceeded, the skylights in the inner panes of the windows are automatically opened, which increases the volume flow of the air change.

The exhaust air ducts are also being reactivated so that used air can be removed by means of natural uplift. Should a sensor measure increased CO2 concentrations, an exhaust fan will be switched on to provide support. If the respective teaching space is not or only partly occupied, the fan remains switched off. Compared to a standard system, this considerably saves on electricity for powering the vent.

The school is naturally cooled during the summer by means of effective night cooling, which is neutral in terms of the primary energy use. By utilising the double windows and exhaust air ducts and by controlling the exhaust airflow volumes, the existing building mass can be activated and a considerable drop in room temperatures achieved in large parts of the building.

The floor plans are being reworked to improve the daylight utilisation. Old light shafts are being reactivated or supplemented, with louvre blinds integrated in the cavities in the double windows to provide shading, glare protection and to redirect light. In the windows on the east-southeast side, it is also planned to install electrochromic glazing to provide solar shading that will counteract solar gain in these rooms. Any required artificial light will be controlled in accordance with the daylight and switched off centrally when the school closes at the end of the day.

Performance

Information on this subject will become available as the project continues.

Optimisation measures and possibilities

Information on this subject will become available as the project continues.

Construction costs and economic viability

The overall investment costs amount to 8.8 million euros. The project is being sponsored by the German Federal Ministry of Economics and Technology as part of its "Energy-Optimised Construction, EnEff:Schools" subsidy programme.

Educational concept

Once the refurbishment work has been completed, it is planned to provide a display that will illustrate the energy efficiency of the school building to the school pupils, teachers and parents.

Key energy data

Energy indices according to German regulation EnEV (in kWh/m ² a)	before refurbishment	after refurbishment
Heating energy demand	122.69	31.82
Overall primary energy requirement	174.23	48.89
Measured energy consumption	before refurbishment	after refurbishment

data (in kWh/m ² a)	before refurbishment	after refurbishment
Site energy for heating and domestic hot water (dhw)	136.00	

Refurbishment costs

Refurbishment costs in €/m ²	
Total	1.570

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.