"Neue Burse" student residence hall, Wuppertal

EnSan

The student residence hall "Neue Burse", belonging to the Wuppertal University Social Services Office, is one of the largest halls of residence in Germany, with 630 accommodation units. After comprehensive refurbishment of both of the building sections built in 1977, a consumption level equivalent to that of a low-energy house was aspired to upon completion of the first construction stage in 2001 (net floor area: 8,420 m²). In the second construction stage (net floor area: 8,597 m²), completed in 2003, the heating requirement was again significantly reduced due to further improvement of the thermal insulation, and installation of a centralised ventilation system with heat recovery. This section of the "Neue Burse" is currently Germany's largest residential building to comply with the passive house concept.

The buildings of the refurbished "Neue Burse" in Wuppertal (Germany).
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Building summary

Project status	Optimized
Location	Max-Horkheimer-Straße 10-16, 42119 Wuppertal, Nordrhein-Westfalen
Year of construction	1977
Refurbished	2003
Building owner	Hochschul-Sozialwerk Wuppertal (+ Betreiber, Nutzer)
Gross floor area	19,915 m²
Heated net floor area	17,017 m²
Gross volume	56,496 m³
Usable floor area (according to EnEV)	12,384 m²
A/V ratio after refurbishment	0.36 m²/m³
Key aspects	Heat insulation, Facade systems, Glazing + windows, Ventilation + heat recovery

Project description

After a comprehensive appraisal, the contractor (the Wuppertal University Social Services Office) decided on a comprehensive refurbishment of the building. As well as completely out-of-date building services equipment and insufficient thermal insulation of the facade, the hall of residence also had structural faults. The original hall of residence is subdivided into two buildings in a star shape, each with approximately 300 accommodation units. The building sections were arranged around a central, barely-lit staircase, which served as the building's reinforcing structure. All accessibility between the two sections was only provided via a single entrance. As well as the out-dated building services equipment and insufficient thermal insulation, leaky seams were causing moisture penetration of entire building elements.

Refurbishment concept

During the refurbishment, the dilapidated facade, consisting of non-load-bearing slabs hanging in front of the building's shell, was removed. Only the apartments' load-bearing structure was retained. Grouped accommodation, encompassing 32 persons, has largely given way to individual apartments, each with a shower and kitchenette. The space which this requires is made by means of an extension of the building shell's room depth by approximately 2 m. Thus, the new hall of residence is more compact than the old structure. At the same time, the forebuilding becomes the building's reinforcing structure. The staircase or core area was removed from the middle of the building. Thus, two separate buildings are the result. The single-glazed staircase and its adjoining rooms are situated outside the thermal envelope. The building was completely fitted out with prefabricated facade elements with wooden frames and mineral fibre thermal insulation. Several facade elements were combined, then on the construction site they were mounted on the reinforced concrete framework forestructure.

Energy concept

The heat supply of the "Neue Burse" occurs via remote heating from Wuppertal's public utility company. In the first construction stage (CS), the apartments are heated via radiators, and in the second CS via the ventilation system; only in the bathrooms, and in the apartments on the end walls, is a radiator always installed.
In the 1st CS, a demand-oriented air extraction system is installed in each room and bathroom. Supply air can flow in via outdoor air inlets above the windows. Actual ventilation occurs via the windows. The 2nd CS has a centralised air intake and exhaust system with heat recovery.

Performance

The small apartments (18.7 m²) and the insufficient degree to which residents perform window ventilation mean that the indoor air quality does not always comply with the hygiene regulations. In the 2nd CS, these problems do not arise, as the apartments are permanently ventilated with supply air and air extraction. The consumption measurements in 2005 show that the primary energy consumption was reduced by approximately 60% compared to that of the old building. The objective of achieving the low-energy house standard was reached in the 1st CS. In the 2nd CS, the additional savings potential could not be fully tapped by the implementation of components suitable for use in passive houses. At 51.8 kWh/m² p.a., the heating consumption measured in 2005 was still considerably higher than the target value of 30 kWh/m² p.a., and above the original target value of 15 kWh/m² p.a. for a passive house. However, in the heating period 2006/2007, it is expected that the calculated requirement will be adhered to.
From the owner's point of view, the refurbishment of the "Neue Burse" is a success. The building's energy costs have fallen drastically, and long waiting lists for accommodation bear witness to the new attractiveness.

Optimisation measures and possibilities

In the 2nd CS, a number of shortcomings have already been rectified. For example, faulty attachment of mixing valves and circulation losses in supply pipes were successfully reduced. Optimised control strategies offer further potential savings. The realised and planned supply air heating control concept was assessed with the aid of the TRNSYS thermal building simulation program. The simulation showed exhaust-air-temperature-based control to have advantages over the previous control strategy with regard to comfort. However, energy consumption remains somewhat high in comparison to the original planning. Thereupon, the ventilation system was converted to exhaust-air-dependent temperature control in November 2005. Under the specified conditions, heating consumption of 30 kWh/m² p.a. appears to be achievable, which is excellent for a refurbished building. Alongside the technical optimisation work, the residents need to be very well informed of the function of the ventilation system. Here, the conditions specific to student residence halls should be taken into account.

Construction costs and profitability

The residence hall's unattractiveness before the refurbishment led to vacancies, and considerable social problems. This meant that it was no longer possible to run the building profitably. With the refurbishment, the long-term rentability of the hall of residence was improved significantly. The long waiting lists for accommodation confirm this assessment.<//span><//span>

Key energy data

Energy indices according to German regulation EnEV (in kWh/m²a)	before refurbishment	after refurbishment
Heating energy demand	161.00	26.00
Measured energy consumption data (in kWh/m²a)	before refurbishment	after refurbishment
Thermal heat consumption	246.00	
Site energy for heating and domestic hot water (dhw)	285.00	81.50
Source energy for heating and domestic hot water (dhw)	172.00	55.00
Total source energy	210.00	73.30
Auxiliary power, pumps, controlling		0.00
Ventilation (1st construction stage, low-energy building)		2.00
Ventilation (2nd construction stage, passive house)		5.00

Notice: Data for heating energy demand, Site energy for dhw, Source energy for dhw and total source energy are related to the passive house. The data for the low-energy building are 68 kWh/m²a, 97,8 kWh/m²a, 64 kWh/m²a and 75,6 kWh/m²a.

Implementation costs

Implementation costs in €/m²	
Construction (KG 300)	592
Technical system (KG 400)	195

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

Refurbishment costs

Refurbishment costs in €/m²	
Structural design 1st construction stage	515
Structural design 2nd construction stage	668
Technical facilities 1st construction stage	194
Technical facilities 2nd construction stage	195

These figures represent established costs

Operating costs

Operating costs in €/m²a	before refurbishment	after refurbishment
Total energy costs		15.00
Total electricity consumption		6.00

Projektinfo by BINE Information Service
Scientific data from long-run monitoring (in German)

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