

Centre for Environmentally Conscious Construction



The ZUB in Kassel (Germany) describes itself as a "link between theory and practice". It serves as both a research building and a demonstration building, as due to the establishment of an experimental area and a flexible facade, it offers the possibility of examining innovative construction concepts in real installations. This new building, designed for energy efficiency, is also architecturally attractive, as it is built onto an historic university building, thus filling a gap between buildings in the inner city.



The glazed south facade of the ZUB Kassel, allows an ideal use of daylight.
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Building summary

Project status	
Location	Gottschalkstraße 28a, 34127 Kassel, Hessen
Completion	04/2001
Inauguration	2001
Building owner	Zentrum für Umweltbewusstes Bauen e.V. (+ Betreiber, Nutzer)
Heated net floor area	1.732 m ²
Gross volume	6.882 m ³
main usable floor area	830 m ²
A/V ratio	0,34 m ² /m ³
Key aspects	Heat insulation, Daylight planning, Optimised lighting, Ventilation + heat recovery, Regenerative + passive cooling, Thermo-active building element systems, Heat / cold storage

Project description

The Centre for Environmentally Conscious Construction (ZUB e.V.) serves to interconnect three subject areas at the University of Kassel: construction physics, experimental construction, and technical equipment in buildings. The goal is to put the progress made in these areas into practice. A high degree of incorporation into the teachings of the university has been ensured, as many of the planning consultants were members of the departments in question. The ZUB building reflects the state of research in the area of environmentally conscious construction, serving the ZUB's researchers as a workplace, and above all as a demonstration site.

Building concept

By means of a "light gap", the building joins onto the fire wall of an existing 19th-century brick building. The proportions and dimensions of the new building are based on the existing building, and complement it by forming a modern counterpart. An almost shade-free southern orientation is enabled by the location of the real estate, and supports the energy-oriented planning objective of natural illumination. On the south side, the mullion-and-transom curtain wall facade made of wood and aluminium is glazed to ceiling height. The thermally insulating triple glazing is combined with exterior sun protection. Vacuum insulation panels are situated in front of the outer face of the slabs. Window surfaces oriented to the east and west are minimised for reduction of summer heat.

This new 3-storey building has a cellar, and its corridors have rooms only on one side; the light gap provides vertical and horizontal integration with the existing building. The rooms are arranged in single rows around this integration area.

Energy concept

When planning the new ZUB building, the approach focussed on achieving a heating requirement of less than 25 kWh/m² p.a., implementation and analysis of thermo-active building elements, extensive natural ventilation and illumination, a good interior climate in summer, and passive utilisation of solar energy.

Thus, a compact building form with a favourable A/V ratio of 0.34 1/m was selected. All exterior building elements are equipped with a high degree of thermal insulation. As the construction is an extension of another building, heat losses at the side facade are almost completely eliminated.

Another feature of the building is the cavity wall construction: a non-load-bearing wall made of unburnt clay bricks which forms the "spine" of the offices. The wall's large thermal mass has a positive effect on the temperature conditions in the rooms.

For heating and cooling, only panel systems are implemented, with the exception of radiators in the sanitary facilities. All floor slabs have conventional underfloor heating. In addition, pipes are laid on the lower reinforcements for concrete core activation. This makes it possible to analyse different operating methods on the basis of measurements.

The ventilation system with heat recovery is designed for a maximum volume flow of 4,000m³/h and is regulated according to air quality (VOCs). It encompasses two separate ventilation areas (lecture theatre and office area) which can either be operated in parallel or one at a time. If the volume flow is insufficient for the office area, additional ventilation via the windows is necessary. Indeed, throughout summer, window ventilation is the intended method for the offices.

For cooling in summer, it is possible to use either overnight ventilation, or alternatively the thermo-active ceilings in heat exchange with the foundation slab. A chiller is not installed.

Performance

The heat consumption of 25 to 30kWh/m² p.a. is very close to the calculated requirement, and at the same time is far lower than the requirements of the support concept. The electricity consumption for building services equipment, lighting, and working equipment is relatively low. The daylight-dependent artificial lighting control, and the demand-controlled ventilation have brought high savings in comparison to standard operating methods. The implemented ventilation concept, which entails mechanical ventilation in winter, and window ventilation in summer, has proven itself during the years of operation measured.

With the aid of panel systems (underfloor heating and ceiling system), heating outputs reaching 80W/m² and cooling outputs reaching 40W/m² have been achieved.

Optimisation measures and possibilities

In the first winter, the underfloor and concrete systems were operated in parallel. In the second heating period, the only heating system used was the underfloor system. This shift did not alter the energy consumption, nor the thermal comfort.

For heating and cooling in other new buildings, simultaneous implementation of underfloor heating and concrete core activation will generally not occur. In the ZUB, this serves primarily for purposes of experimentation. Here, the system of concrete core activation has proven itself in principle, despite it being perceived as too slow by some occupants.

Construction costs and profitability

There will seldom be such favourable initial conditions for a new building, also with regard to costs, as there were in this case: the northern facade was built onto an existing building, so to a certain extent, the existing building's infrastructure could be shared.

The implementation of foundation slab conditioning is cost-effective, and particularly practical if internal and external loads can be limited by means of additional measures.

Key energy data

Energy indices according to German regulation EnEV (in kWh/m ² a)	
Heating energy demand (according to the German regulation WSVO 95)	16,50
Measured energy consumption data (in kWh/m ² a)	
Thermal heat consumption (in 2003, based on heated net floor area)	24,70
Total source energy (in 2003)	39,40
Building services, lighting, working appliance	18,70
Lighting	3,50

Implementation costs

Costs of implementation in €/m ²	
Construction (KG 300)	769
Technical system (KG 400)	301

These figures represent established costs

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