Hübner production hall

EnBau

This hall stands out well from the cheap concrete and steel monotony of most industrial halls. Despite very tight restrictions on costs and planning time, it proved possible to build a production hall that was ambitious both architecturally and with regards to energy. Lofty goals were formulated regarding the use of daylight, and regarding the clever displacement ventilation system with heat recovery, which completely abandons the use of fans in normal operation. Wood, and other construction materials which are unobjectionable in terms of building ecology, bring a very good ecological balance. In practice, it was not possible to achieve all objectives, but nevertheless the project is a prime example of the scope for action in the construction of industrial and commercial halls.

The exterior view of the Hübner production hall.
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Building summary

Project status	
Location	Heinrich-Herz-Straße 2, 34123 Kassel, Hessen
Completion	1998
Inauguration	1998
Building owner	Hübner Gummi & Kunststoffe GmbH (+ Betreiber, Nutzer, Investor)
Heated net floor area	2.122 m^2
Gross volume	17.195 m^3
	2.063 m^2
A/V ratio	0,42 m^2/m^3
Key aspects	Heat insulation, Daylight planning, Ventilation + heat recovery, Regenerative + passive cooling, Solar thermal energy, Ecology of building materials

Project description

The contractor initially wanted a 5,000 m² production hall, largely made of wood, with total costs below €510 per square metre. The planning team, the core of which at first consisted of the architect, a structural engineer, and an expert for the energy concept and simulation, drew up a plan for a multi-aisled hall made of nail-laminated timber, with extensive use of ecologically unobjectionable construction materials, and with naturally convective ventilation following the displacement ventilation principle. The planning team was extended to include partners for project management and controlling, daylight planning, colour design, fluid-dynamic simulation, ecological balancing, and for the scientific evaluation. Subsequently, several changes of plan were initiated by the contractor. Thus, within just 6 weeks, a new plan had to be drawn up for what was now a hall of only 2,000 m².

Building concept

The main carrier beams of the 33m x 62m timber frame construction are perpendicular to the hall's longitudinal axis. The main and secondary carrier beams are made of laminated timber, and are implemented as timber framework beams. The exterior wall is a prefabricated insulated timber frame construction, cladded on the outside with ventilated larch planking. The insulation of the foundation slab, which is unusual for a production hall, consists of foamed waste glass fill. The roof, made of trapezoidal sheeting, has 18cm-thick insulation, and the wooden windows have conventional thermally insulating glazing. The roof is implemented as a saw-tooth construction with vertical skylights facing north-east, which serve to vent air, and to allow daylight in.

Energy concept

The industrial hall has very good thermal insulation, and a favourable A/V ratio. Heating and cooling is performed with controlled ventilation: the thermal buoyancy in the hall is sufficient to drive fresh air through the underground duct into the hall, and to drive air out of the hall through the exhaust air flaps. By means of the supply air, the hall is cooled in summer, and heated in winter. The degree to which the smoke and heat vents are opened controls the amount of air fed into the hall. Thus, an airtight design is essential for the building envelope. When required, the hall is heated by means of the company-owned local heating system via a heat exchanger in the air supply duct (and if necessary, also via radiant ceiling heating).

Performance

Initially, although the heating energy consumption was 60% below that of a standard precast concrete hall, it was considerably higher than the planned value of 22 kWh/m² p.a., which was due to a number of factors, most of which were later successfully rectified. After several optimisation measures, the heating energy consumption in 2000/2001 was then 80 kWh/m² p.a. The unique ventilation concept functions well, especially in summer, but in winter, doors which remain open for long periods are a problem. The level of daylight is not optimal; therefore the artificial lighting is often permanently in operation at full power. Here, the structural design of the timber support frame reduces the level of daylight possible.

Optimisation measures and possibilities

The underground concrete ducts were made leak-tight, and the airtight properties of the hall were improved (the work on the roof-wall connection was very expensive). Finally, the desired value of n50=1 h-1 was achieved in the pressure test, and the ventilation system functioned faultlessly. Retrofitting with a second high-speed door successfully reduced the heat losses further, as the hall doors are open less often.

Construction costs and profitability

Although the contractor wanted the ecologically advantageous construction material wood to be used as much as possible, this was subject to the condition that the construction costs be kept below €510 per square metre. In terms of costs, the ambitious building concept that developed out of these stipulations found itself in constant competition with a standard industrial hall throughout the long and complicated planning phas

Key energy data

Energy indices according to German regulation EnEV (in kWh/m²a)	
Heating energy demand (based on net floor area)	22,00
Measured energy consumption data (in kWh/m²a)	
Thermal heat consumption (based on net floor area, 2001)	83,40
Total source energy	162,90
Electricity for building services and equipment	18,20
Only lighting	16,50

Data 2001, related to heated net floor area

Implementation costs

Costs of implementation in €/m²	
Construction (KG 300)	578
Technical system (KG 400)	87

These figures represent estimated costs

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