SOL4 BUSINESS AND TRAINING CENTER EICHKOGEL

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Summary

SOL4 is an exemplary pilot project in a new semi-urban district for the sustainable construction of a working and living environment. The building complex serves as a business and training centre, as well as a centre of competence for advanced standards in ecological development, construction and workplace design. It is currently the largest passive solar office building in Austria. The skills and experience from a broad range of the project partners and associates were brought together in a common infrastructure and seminar programme for tenants. The resulting living and working environment includes relax areas and other social spaces.

The technologies and design objectives implemented in the project sought to maximise “green” surfaces (e.g., green roof systems, open infiltration surfaces, etc.). Special attention was paid to using the latest developments of environmentally friendly construction materials as extensively as possible. The facility’s energy management system optimises ventilation and air conditioning by means of a closed-loop heat distribution circuit with ground-coupled and ventilation heat exchangers. Passive cooling is enabled by concrete core activation in the panels of the roof construction. The grid-tied photovoltaic system provides electricity to cover the remaining energy demands of the mechanical systems. Finally, SOL4’s overall ecological performance is being monitored and continually analysed with total quality assessment methods.

1. Introduction

Situated directly at the foot of the Eich Hill (“Eichkogel”) Nature Reserve, Lower Austria’s town of Mödling is expanding its communal infrastructure to include a new district to promote the exchange of knowledge through a network of state and private professional training centres, clustered with nearby educational institutions. Existing energy resources and infrastructure are shared with businesses already established in the region.

In this context, the building complex named SOL4 serves as a business and training centre, as well as a centre of competence for advanced standards in ecological development, construction and workplace design. The technologies and design objectives implemented in the project sought to maximise “green” surfaces in this semi-urban setting (e.g., green roof systems, open infiltration surfaces, etc.). Initiated in April 2003 and completed January 2005, it is currently the largest passive solar office building in Austria (figures 1 and 2).

Social aspects also played a vital role in the approach to integral design and dedication of the facilities. The skills and experience from a broad range of the project partners and associates (facility managers, graduates of the Danube University in Krems, WIFI Mödling, experts on passive solar buildings and from the Austrian Institute for Healthy and Ecological Building) were brought together in a common infrastructure and seminar programme for tenants. The resulting living and working environment includes relax areas and other social spaces. The necessary understanding of ecological construction technologies was provided to the involved craftsmen in accompanying professional training programmes.

Industrial partners included manufacturers of innovative construction materials (Wienerberger, BAUMIT, STO, Knauf) and the Association of Austria’s Brick Industry. The Austrian Federal Ministry for Transportation, Innovation and Technology supported project development in the framework of the “Building of Tomorrow” initiative (see references). Meanwhile, all of the facilities have found their future tenants, who will form a state-accredited Centre of Excellence for Sustainable Building.

2. Ecological Design and Construction Criteria

A heightened public awareness of the need for environmentally friendly building design concepts can be observed worldwide, be it in political terms (e.g., Kyoto Protocol, cf., European Commission Directive 2002) or as mandated in increasingly stringent technical standards (cf., CEN/BT-WG 173 2004). The demands placed on the specific competence of building design practitioners have shifted accordingly (cf., Goulding et al. 1993, University College Dublin et al. 1999).

In the German-speaking countries of Europe, a "passive house standard" ("Passivhaus-Standard") has been established to denote buildings that provide comfortable conditions in both the winter and summer seasons with a minimum of auxiliary building services (cf., Feist et al. 1998, Faninger 2004). The quantitative performance criteria for such buildings are defined in terms of annual auxiliary heating energy demand, which cannot exceed 15 kWh/m² by declared calculation (EN ISO 6946, 10456, 13370, 13786, 13790). The risk of overheating under summer conditions must be considered and, for non-residential buildings, the cooling energy demand estimated (EN ISO 13789, prEN ISO 13791 and 13792). Finally, the quality of the building's outer fabric must be proven in terms of air tightness by the fan pressurization method (DIN EN ISO 13829:2000, "blower door test"), in which the air change rate at 50 Pa remains less the $0.6h^{-1}$.

Beyond improving the overall thermal comfort and quality of the built environment, such a generally applicable set of building standards is also an effective measure for reducing the auxiliary energy demand of new construction to meet global sustainability criteria. It forms the basis for enabling energy needs to be met entirely with renewable resources, since such energy resources are both limited in availability and potentially more expensive than non-renewable alternatives (cf., Energieverwertungsagentur 2003, US-DOE 2005).

A building that meets such stringent performance criteria is clearly more than just the sum of its components (see next section), that is, it takes more than the accumulation of appropriate components to make a successful "passive house."

Ultimately, an effective interplay between strategic components can only be achieved through a fully integrated design process. Thus energy efficient building design requires good communication between the architect and the building services engineer, ideally from the very start of the design process.

The overall ecological performance of the result of this two year process – SOL4 – is being monitored and continually analysed with total quality assessment methods (SOL4, IBO 2005; cf., Fraunhofer Institut 2005).

Figure 1 Grand opening of SOL4, January 26th, 2005(photo courtesy of Thule G. Jug).

3. Construction Materials and Building Components

Special attention was paid to using the latest developments of environmentally friendly construction materials as extensively as possible.

The load-bearing structure is made of locally engineered materials used here for the first time: cement-free concrete and brick masonry with optimised storage capacity. As shown in figures 2 and 3, the thermal envelope is assembled with innovative materials as well: mineral foam insulation and prefabricated structural panels made of straw and oriented-strand board (OSB) with a photovoltaic cladding system (prototype of "clip-on" façade system).

High-performance windows with gas-filled multiple glazing were installed and equipped with an advanced shutter system for shading and protecting the office spaces from excessive solar gains. In addition, non-ceramic clay bricks were used for the first time as interior office walls. A specialist on construction biology and chemistry was involved to ensure a minimised negative impact of the finishing materials in terms of health and environmental costs (non-toxic materials, solvent quantities reduced to absolute minimum, etc., Tappler et al. 2000).

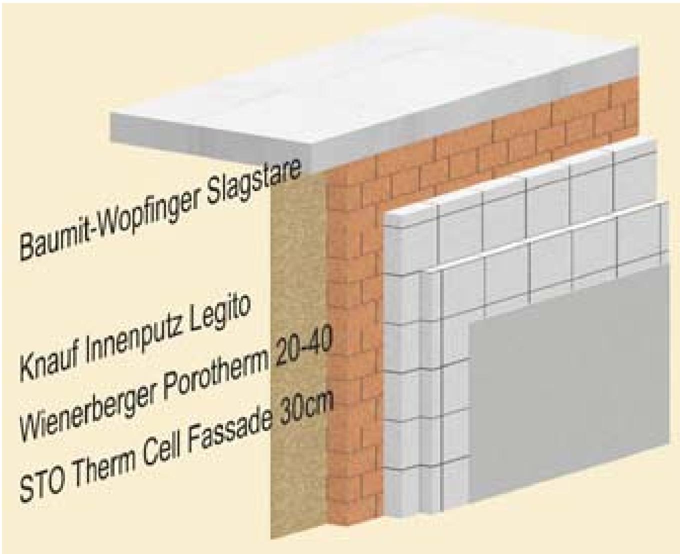

Figure 2 Insulated brick wall construction: Therm Cell® mineral foam board (STO), Porotherm® brick masonry (Wienerberger), Legito® interior stucco (Knauf), Slagstare® cement-free concrete (Baumit-Wopfinger).

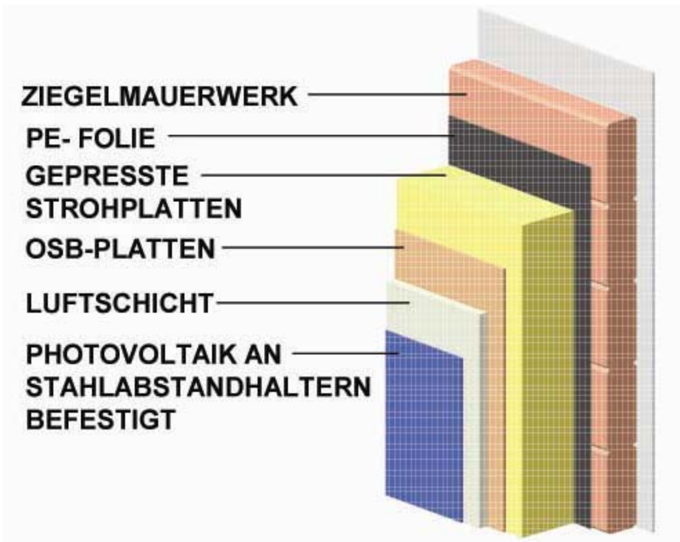

Figure 3 Photovoltaic façade construction: photovoltaic panel (clip-on system), air space, oriented-strand board, compressed-fibre straw panel, polyethylene foil, brick masonry wall, interior stucco.

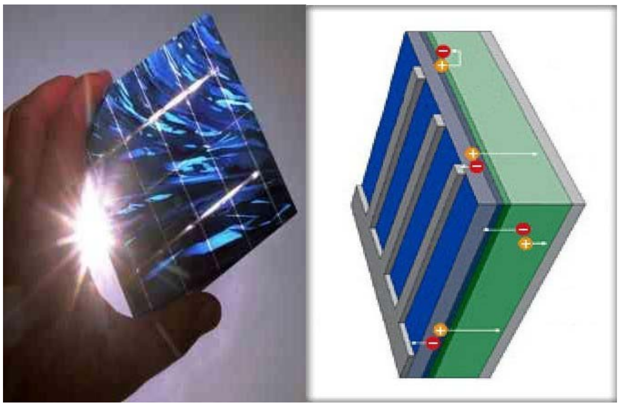

Figure 4 Photovoltaic cells (photo courtesy of Soltech: http://www.soltech.de; diagram courtesy of Suntechnics: http://www.suntechnics.de).

4. Integrated Systems and Energy Management

The term “passive solar building” on the whole reflects the objective of making extensive use of the energy resources already available in a building’s basic form and functions, such as the solar gains through windows or casual gains from occupants and equipment, to cover as much of the overall energy demand as possible. Good integration of mechanical and electrical services with passive systems is required to obtain maximum benefit from this ambient energy (cf., University College Dublin 1999, Goulding et al. 1993).

The building services fully respond to the demand for a variety of advanced passive energy-use technologies. The facility’s energy management system optimises ventilation and air conditioning by means of a closed-loop heat distribution circuit with ground-coupled and ventilation heat exchangers (cf., prEN 14335, EN ISO 12599, OeNORM G 6000-3:1989).

Vertical boreholes enable earth-to-air cooling, that is, passive cooling by concrete core activation in the panels of the roof construction. The grid-tied photovoltaic system provides electricity to cover the remaining energy demands of the mechanical systems (cf., Haas et al. 2004).

Figure 5 Photovoltaic cladding system and building services control room with grid-tied supply switching system, designed and installed by ATB Becker, Absam, Austria.

Figure 1 East façade of SOL4, January 2005 (SOL4 2005, photo courtesy of Thomas Kirschner).

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