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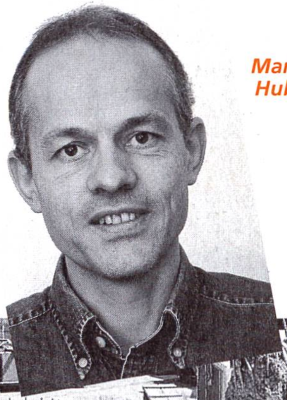
ZURICH AIRPORT

Heating and cooling using thermal piles



Markus Hubbuch

In the new docking building at Zurich airport, foundation piles are being used to provide energy: a substantial proportion of the heating and cooling requirements is being met by using the ground as a heat sink.

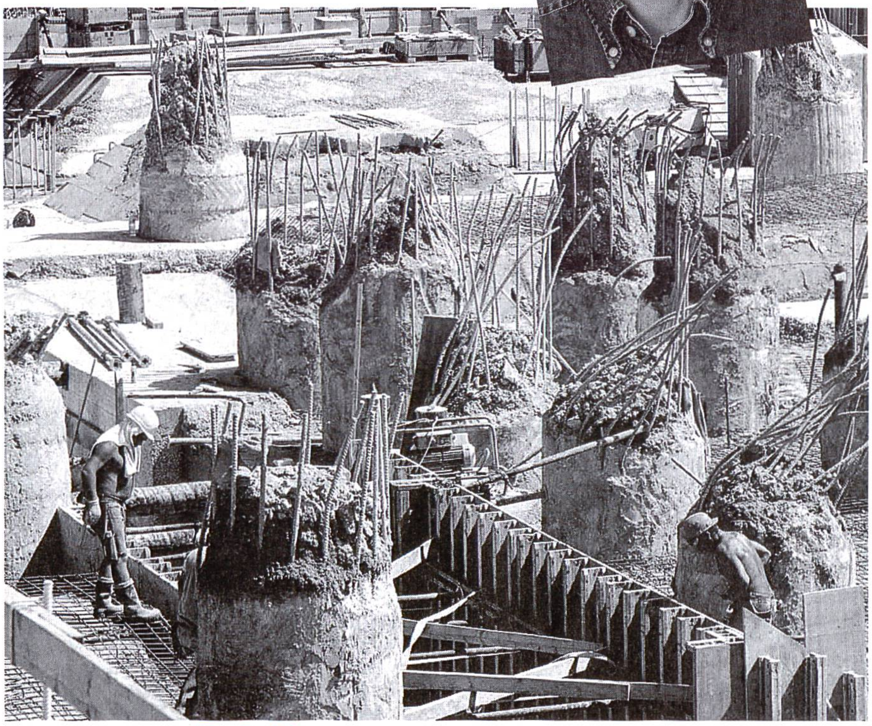
Because of the poor subsoil, Zurich Airport's Dock E (formerly *Midfield*), which was opened last autumn, is built on pile foundations. These columnar supports of reinforced concrete extend down to a depth of 30 metres. Only at this depth does the moraine provide a stable substrate.

Recovering energy. The unfavourable geological conditions, however, were also an opportunity for a trailblazing energy project: the foundation piles are also being used to recover energy. They are equipped with plastic tubes in which a mixture of water and glycol circulates. Warmth for heating is extracted from the ground in winter by this liquid. Conversely, in the summer the system is used to cool the building by conducting excess heat into the ground.

"We provisionally expect to cover 60 to 70 percent of heating and cooling requirements using renewable energy," states Markus Hubbuch. When he was designing the energy pile system, he was employed by the engineering company *Amstein + Walthert AG* in Zurich. Within ARGE ZAYETTA, the general design consortium for the *Midfield* dock, this company was responsible for total design of building services engineering.

Today, Hubbuch is the Professor for Energy and Building Services Engineering at the University of Wädenswil, where he also heads the Institute for Facility Management. "Thanks to the energy piles and better insulation, energy consumption per square metre of the surface area of Dock E is two to three times less than for the other terminals at Zurich airport," calculates Hubbuch.

Economical. The use of energy piles is a voluntary measure by the client. However, the additional investment of CHF 970,000 is worthwhile, as it reduces annual operating costs by CHF 94,000; the net annual benefit – including depreciation – is therefore CHF 16,000. This figure assumes a write-off period of 30 years, an interest rate of 5.5 percent and an energy price of CHF 0.08 per kWh of heat and CHF 0.166 per kWh of electricity.



The Zurich "energy piles"

Although it is not the first application of energy piles, the Dock E system breaks new frontiers, firstly due to its size: the dock building is 500 m long, 34 m wide and 21 m high. Of the 440 piles, 310 are used for heat transfer.

Preparing the inserts for the piles in the factory meant that the on-site welding work on the plastic pipes could be reduced to a minimum. Thus the tight schedule for the construction work could be complied with and the required high quality levels could be assured.

Measurements. With a view to optimal design, specialists from the EPF Lausanne used probes to measure the thermal conductivity of the subsoil on site and then carried out detailed simulations.

The Swiss Federal Office of Energy provided financial support for this preliminary work and therefore made a critical contribution to making this system a reality. It will now pay for a two-year measurement project, allowing the performance of the system to be examined in detail. The project will be implemented by the *Scuola Universitaria Professionale della Svizzera Italiana* in cooperation with *Amstein + Walthert* and the University of Wädenswil.

A yearly cycle

In winter exhaust heat is primarily recovered from the circulating air circuit in Dock E. If this is not sufficient to cover heating requirements, the energy piles come into play: the liquid used to carry heat emerges from the pipe manifolds at approximately 8°C (about 4° below the soil temperature); it is cooled by a few degrees in a heat pump, delivering heat to the heating system, and is then fed back to the manifolds, where it warms up again to about 8°C – and the cycle begins again. Additional heat supplied from conventional external sources is only required on very cold days.

In summer the relatively cold liquid is used to cool the circulating air circuit. It then transfers the heat to the ground via the energy piles. The electricity savings compared with cooling using chiller units offset the power consumption of the heat pump in winter. In summer, only a few peak situations require the use of the heat pump in cooling mode for additional cooling of the circulating air. Then the outside air for the fresh-air installations is cooled down in summer by chiller units to approximately 19°C.