CADDET energy efficiency
IEA / OECD
AIVC #9909
Improving thermal quality of buildings

Overall retrofit of Swiss apartment blocks

Summary

In the near future a large number of dwellings in Switzerland dating from the 50s to the 70s will need to be retrofitted in order to upgrade the comfort levels to today's standards and to reduce the energy consumption. By carrying out an overall retrofit of both the envelope of the building and the building services this can be successfully accomplished.

Two retrofit projects of apartment blocks, one in Meilen and one in Cossau, demonstrate how a well-balanced strategy can achieve a comprehensive and economical retrofit. These projects feature standard retrofit measures and additional measures recommended in a study carried out by an energy consultant.

Highlights

- **Simple, energy-efficient measures**
- **Annual heat consumption reduced by 30-50%**
- **Increased comfort level**

Front view after retro-fitting of the Meilen project.

Aim of the Project

The houses and apartment blocks in Meilen and Gossau (referred to as the Mettendorf complex) are typical of thousands of dwellings in Switzerland built in the 50s to 70s. After many years of occupation these buildings need to be renovated and much equipment needs to be replaced. Instead of carrying out retrofits on a piecemeal basis, it is more efficient to carry out an overall retrofit supported by an energy study. Control of the heat flow through the envelope by increasing the building's thermal properties with simple measures is still one of the most essential parts of the energy efficiency design strategy. The projects described in this brochure should serve as a useful model to encourage the retrofit of similar buildings

The Principle

Improving the thermal quality of the envelope of a building is the most significant factor in reducing a home's energy consumption for space heating. By adding insulation to the existing exterior wall, roof and foundation/basement, the thermal resistance of the envelope of a building will increase and therefore the heat loss through the envelope will decrease. Replacement of windows with single and double glazing by high-performance windows is an integral part of an energy-efficient building envelope. The addition of external roller-shutters will even improve the energy efficiency of the windows.

An energy study carried out by an energy consultant can result in additional cost-efficient, energy-saving technologies such as upgrading of the heating and ventilation system. The energy consultant can also supervise the retrofit progress on site, and monitor the building's thermal performance after completion of the retrofit.

Due to the improvement of the thermal quality of the building envelope not only will energy be saved, but also the comfort level will increase because of higher wall temperatures, less noise and fewer draughts. By installing new kitchen equipment and new pipework (for drinking and waste water) the comfort level of the apartments will increase even more.

The Situation

The multi-family houses in Meilen were built in 1957 and needed to be renovated. The owner of these buildings is an experienced professional in building ownership and has a list of proven measures which have become standard in all their retrofit projects. In addition, an energy consultant was engaged to carry out a comprehensive energy study.

The building owner's standard retrofit measures included:

- addition of a new curtain-wall facade to the existing brick wall. This new curtain-wall facade incorporates an 8 cm layer of mineral fibre and an "eternit" slate cladding;
- addition of roof insulation;
- replacement of the existing double glazing in the apartments by heat-reflecting glass units with synthetic frames, and replacement of the single glazing of the staircase roof by new units;
- replacement of all external roller-shutters and doors;
- new, downsized oil-fired boiler;
- new kitchen equipment;
- new drinking and waste water pipework;
- new and bigger balcony;
- external and landscape work.

The additional measures from the energy study included:

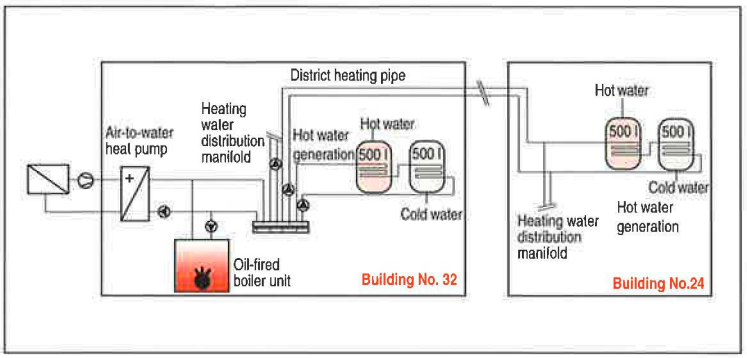
- upgrading the heating system incorporating a new air-to-water heat pump;
- new lighting in stairways;
- washing machines with hot water inlet;
- energy saving instead of standard kitchen equipment.

A new, air-to-water heat pump is now integrated in the heating system, providing independent

Table 1: Thermal performance data of the Meilen project.

	Before	After retrofit
U-value facade	0.93	0.34 W/m²K
U-value apartment windows	2.6	1.60 W/m²K
U-value staircase roof window	5.40	1.80 W/m²K
U-value roof	1.03	0.24 W/m²K
Boiler peak heat output	249	90 kW
Heating pump heat output	–	35 kW

Figure 1: Schematic operating principle for heating and hot water in the Meilen project.



generation of hot water outside the heating season. In winter, the heat pump supplies basic power for heating and hot water generation. Refrigerant R 134a with an ODP (Ozone Depletion Potential) of zero is used in the heat pump. The new, downsized oil-fired boiler only works as a supplier of peak power. Hot water is stored in two new 500 litres heat storage tanks in each multi-family house. These heat storage tanks are fed from the central boiler

During the retrofit period, all occupants were able to stay in their own apartments. They were informed two years in advance about the proposed retrofit, the time schedule of the project and estimated rent increases for their renovated apartments. All occupants were able to accept the inconveniences.

The retrofit of the apartments in the Mettendorf complex is quite similar to the retrofit project as described in Meilen. Although the retrofit measures of the heating system of the Mettendorf project are not as extensive as the measures taken in the Meilen project, the total retrofit resulted in significant energy savings. The thermal performance data of the Mettendorf project are given in Table 2.

The Organisation

The Meilen project consists of two adjoining multi-family apartment blocks, which were built in 1957. Each block has 25 apartments with 2 to 4 rooms. The total floor area per apartment block is 1,590 m^2, and the heated floor area is 1,110 m^2.

The Mettendorf project consists of 15 identical apartment blocks, which were built in the 60s and 70s. Each block has 16 apartments with $4^1/_2$ rooms

Economics

The total investment for the two apartment blocks in Meilen was CHF 4 million. About CHF 0.6 million of this investment was related to the energy saving measures, including building envelope, heat pump and the hot water storage tanks. Although the electricity consumption increased after the retrofit, the total annual heat consumption (MJ/m^2) decreased by 34% thanks to the reduction in oil consumption, as shown in Table 3. The annual energy cost savings amount to CHF 20,000. This results in quite a long payback period for the total project which is due to

Table 2: Thermal performance data of the Mettendorf project.

	Before	After retrofit
U-value facade	1.17	0.32 W/m^2K
U-value windows	2.80	1.70 W/m^2K
U-value flat roof	0.67	0.23 W/m^2K
U-value basement ceiling	1.45	0.54 W/m^2K

Table 3: Annual energy data of the Meilen project (for both multi-family houses).

	Oil consumption for heating	Electricity for heating and hot water	Heating energy figure
Before retrofit	22,000 kg	46,000 kWh	430 MJ/m^2
After retrofit	5,000 kg	65,000 kWh	285 MJ/m^2

the relatively high cost of the new heating and hot water system.

The total investment for each apartment block in the Mettendorf complex was CHF 995,000. CHF 537,000 of this investment was spent on the energy saving measures. The annual energy consumption in this project decreased by 50%. The annual energy cost savings amount to CHF 290,000, which results in a simple payback period of 1.9 years.

Meilen project

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* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA

The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the 23 IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology, and research and development (R&D).

This is achieved, in part, through a programme of energy technology and R&D collaboration currently within the framework of 35 Implementing Agreements, containing a total of more than 60 separate collaboration projects.

The Scheme

CADDET functions as the IEA Centre for Analysis and Dissemination of Demonstrated Energy Technologies. Currently, the Energy Efficiency programme is active in 15 member countries.

This project can now be repeated in CADDET Energy Efficiency member countries. Parties interested in adopting this process can contact their National Team or CADDET Energy Efficiency.

Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET Energy Efficiency 'Demo' or 'Result' respectively, for on-going and finalised projects.

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