Les Charpentiers, Morges

Project summary

Energy concept: Insulation, ventilation with heat recovery, passive solar facade

Background for the renovation – reasons

The goal is to renovate a building aged 45 years and to reduce the heating demand by 90 % (estimation before measurements). The energy related renovation measures are:

- Improvement of the facade and roof energy efficiency (insulation – windows)
- Reduction of ventilation heat losses by adding a mechanical ventilation with heat recovery. Each apartment has its own air handling unit (AHU)
- Use of innovative system for heating and domestic hot water distribution (instantaneous water heaters with heat exchanger)
- Improvement of lighting efficiency in common areas

Site:	**Morges, Switzerland**
Altitude:	373 m
Heating degree days:	2375 (12/20 ºC)
Cooling degree days:	-
Owner:	Caisse de pension COOP
Architect:	Patrick Hellmüller (Renovation)
Engineer:	Swissrenova

Contact Person:	**Mr. Sergio Viva** Caisse de pension de la COOP
Important dates:	Renovation between 2010-2012
Date completed:	November 2013

Building description /typology

- 5-storey with 61 / 59 flats (before / after)
- Year of construction: 1964-65
- GHFA: 4280 /4836 m2 (before / after)

South and East facades - Before renovation

After renovation

Building envelope, heating, ventilation, cooling and lighting systems before renovation

Description of the building and its situation before renovation (building situation, building system, renovation needs, renovation options)

The five-storey building is located in the city centre of Morges (Switzerland). The ground floor is a shopping centre and has not been renovated. The remaining storeys are composed of residential apartments. The four first floors were built in 1964-65. The last attic floor was added in the 80th. On the South and East facades there were balconies (covered during the renovation) and the total number of apartments was 61.

Heating, ventilation, cooling and lighting systems before retrofit

The energy source was gas. The boiler and the DHW storage were located in a technical room. For each apartment, one water distribution system provides energy for heating and for DHW.

The flats were equipped with an exhaust ventilation from the bathroom and kitchen (simple exhaust ventilation).

No special lighting system was used and no cooling device was installed.

Kitchen before renovation

Building envelope

Exterior walls with almost no insulation. During 45 years, no renovation work has been performed, so the building needed a complete renovation of the apartments and of the building envelope.

Living room before renovation

Element	Area m² before/ after	U-Value before renovation W/m²K	U-Value after renovation W/m²K
Façade	817.6 / 1235	0.36 – 3.06	0.13 - 0.34
Windows	1014 / 699	3.13	0.79
Roof (atic)	728.8 / 802.2	0.38 - 0.61	0.20
Roof (terrace)	150.7 / 296.5	1.28	0.13
Floor against exterior	32 / 168.5	1.18	0.15

Energy renovation features

Energy saving concept

- Pre-fabrication of passive solar facade (system gap-solution: www.gap-solution.at)
- A mechanical ventilation system with heat recovery has been installed in each apartment and an individual controller to allow tenants to reduce the electrical demand of the AHU
- Individual heat meter to make tenants more responsible of their heat consumption
- LED for common areas

Building

The renovation of the building thermal envelope was obtained by adding a pre-fabricated module on the existing facades and balconies. This solution increases by 14% the total heated gross floor area while the apartment size is increased by 22%. In addition, the heat losses through thermal bridges are dramatically reduced.

In each apartment, heat is distributed through a single system. In the bathroom, this heat is primarily used for the heating system (single radiator). If DHW is required, the heat is redirected to a heat exchanger to heat the domestic cold water (Swiss frame system).

The kitchen and bathroom facilities were completely renovated

Systems

Heating: Gas cogeneration (12 kW_{th} and 5 kW_{el})

Cooling: -

Ventilation: AHU with a heat recovery system

Lighting: LED (for common areas like corridors)

Element (only Block A)	U-Value after renovation W/m²K
Façade	Concrete 200 mm / Mineral wool 180 mm / GAP module
Windows	2-layer low-energy windows + 1 external glass with PVC frame
Roof (atic)	Mineral wool 160 mm / Mineral wool 300 mm
Roof (terrace)	Concrete 200 mm / Mineral wool 300 mm / Bitumen sheet 5 mm
Floor (above heating zone)	Plaster 50 mm / Mineral wool 20mm / Concrete

Pre-fabricated solar facade system from gap-solution

Achieved Energy Savings, CO2 reductions and Life Cycle Costs

Energy consumption for heating before and after renovation:

Total gas consumption (heating)

Before renovation (mean value 2008 to 2009):	424 MWh/year
After renovation (First heating season 2011-2012):	43 MWh/year
Energy savings (heating):	381 MWh/year

Electricity consumption (corridor lightning, lift, laundry, pumps, ventilation):

Before renovation *	19.2 MWh/year
After renovation †	32.4 MWh/year
Energy savings:	-13.2 MWh/year

* No ventilation

† Ventilation with heat recovery

New prefabricated modules during the renovation

Energy savings

The ratio of the heating demand before and after renovation is more than 10. Thus, the annual energy saving is around 380 MWh (117 tCO_2-eq).

The increase of electricity demand is mainly due to AHU added.

Renovation costs and LCC (NPV)		
Craftsmen	8.4 million CHF	1737 CHF/m^2
Consultants	0.8 million CHF	165 CHF/m2
Total	9.2 million CHF	1902 CHF/m2
NPV	21 Years	5%

Kitchen after renovation

Renovated facade

Overall improvements, experience and lessons learned

Energy

Annual savings: 381 MWh, 79 kWh/m^2

Heating demand reduction: ≈90%

Indoor climate

- Better external noise insulation
- Improved IAQ (No discomfort about ventilation noise)
- Improved thermal comfort during the heating season
- No thermal discomfort during summer

Economics

In terms of investment cost, about 40% are due to improvements of the thermal building efficiency. The remaining amount concerns the replacement of the sanitary facilities, kitchen, lift and the change in the configuration of the apartments.

Rents have increased (+ 16%/m^2) but remain within current market value.

Decision process – barriers that were overcome

The challenge was to perform the renovation keeping the largest possible number of tenants. Some tenants have been moved several times.

Non-energy benefits

- Better comfort (noise, thermal)
- New apartment, new sanitary and kitchen facilities
- Larger living floor area

Indoor climate

Practical experiences of interest for a broader audience:

The tenants are satisfied with the improved of facilities, kitchen, bathroom and the refurbish of the apartments.

There are no more balconies but on the other hand they were used only as a storage place.

The fan speed of AHU could be selected by each tenant to fit the desired comfort.

Improved sound insulation is so good that the inhabitants have become accustomed to silence.

Users evaluation

A survey of occupant satisfaction has been sent to all tenants. Regarding thermal comfort, results are as follows:

- 76% comfortable to very comfortable
- 21% moderately comfortable
- 3% uncomfortable

Economic consequences for the tenants

Rent before: 205 CHF/m^2/year

Rent after: 245 CHF/m^2/year

Increase: **40 CHF/m^2/year**

Energy savings: 381 MWh/year

Energy price: 80 CHF/MWh

Savings: 381 x 80=30.480 CHF = **8 CHF/m^2/year**

General data

Summary of project

Different aspects were analysed and measured:

- U-value of the renovated facade
- Energy consumption for heating and domestic hot water production
- Thermal comfort during several representative periods
- Efficiency of the ventilation heat recovery
- Ventilation's noise distribution in apartments
- Air quality (CO2 and VOC)
- General feeling and behaviour of tenants (opinion survey)

The combination of the thermal envelope renovation and the addition of the individual ventilation system has led to a reduction by a factor of 10 in the energy consumption while providing an excellent comfort.

Experiences / lessons learned

This project was able to show:

- Only one radiator per apartment can be considered
- Reductions by a factor of 10 in the heating energy demand can be achieved
- For the building owner, it is essential to renovate with tenants into the building in order to keep as many as possible. Thus, a great attention is given to communication with tenants and management of successive removals. After renovation, half of the initial number of tenants remained in the apartments.
- The role of caretaker is important for inform tenants regarding the use of the ventilation system and the concept of low consumption building. It is always possible to open the windows contrary to popular belief.

References

[1] S. Citherlet, J. Bony, O. George: Projet Reno-HP, Installation technique décentralisée pour la rénovation à haute performance de bâtiments, OFEN, final report: November 2011, additional report: Dec. 2012.

Aerial view of the building