Lineagården (Denmark)

Energy saving: 44 %

Improved ventilation

PV-modules, Heat recovery ventilation with low electricity use

Project data

Location, address:	Lineagården, Frederiksberg
Region:	Copenhagen
Surroundings:	Old housing blocks
Climate:	Mild and humid
Heating degree days:	2906
Year of construction and renovation:	1920's (construction); 2000 (renovation)
Typology:	Apartment
No of dwellings:	169
Total floor area:	12,437 m^2
Owner:	Privatbo/Frederiksberg Boligfond
Architect and builder:	Klaus Boyer Rasmussen, SolarVent; Privatbo/Frederiksberg boligfond; Cenergia
Costs of energy saving measures:	€ 4.000 per apartment (incl. VAT)
Renovation financed by:	Frederiksberg boligfond, Danish Energy Agency

Fig. 1: Illustration and photo of ventilation towers with solar ventilation towers.

Objectives and Results

The main aim in this project was to improve the ventilation air. New solutions as electricity-saving mechanical ventilation and use of heat recovery, where you can preheat fresh ventilation air and use up to 80-90 % of the heat-content in the used discard-air, were used. By using new and better solutions The Lineagården project successfully obtained some good results.

Renovation concept

Key renovation features

- Heat recovery in the winter;
- Natural ventilation in the summer;
- Energy saving, low electricity consumption, heat recovery ventilation (EcoVent);
- Utilisation of solar energy; preheating of ventilation air in Canadian Solar wall
- PV modules in some solar ventilation towers
- Improved indoor air climate;
- Possibilities of use of different types of cover, e.g. Canadian Solar Wall and PV-modules.

State-of-the-art

Before renovation	After renovation
Constructions:	*Constructions:*
Single glazed windows	New low energy windows
	Installations:
	○ HRV system
	○ PV system

Energy saving and monitoring

Measured district heating consumption
Before renovation: 149 kWh/m^2
After renovation: 84 kWh/m^2

Percentage saving[1]: 44%

Additional information

- The solar towers do partly function as solar walls and partly as space for ducts for ventilation air to and from the flats. The towers have been built as narrow boxes that follow the sides of the existing stairways (backstairs). For each stairway there are therefore two solar towers, one on each side of the stairway.
- The actual solar wall has been built as the Canadian Solar wall that consists of perforated plates of aluminium. The outside air is drawn through the many small holes in the plates which secures a good heat transition between plate and air. Air is thus taken in over the entire surface of the solar wall. The fresh air is drawn to a heat exchanger on the attic through the gap that is created of the hole between the solar wall plate and the fresh air and exhaust ducts behind.
- The ventilation tower concept has been developed with a special view to renovation of old houses where it is difficult in practise to integrate good ventilation systems, e.g. because it can be difficult to find space for the necessary ventilation ducts. The idea is to place a ventilation tower outside the building in an architecturally attractive way and integrate fresh air and exhaust ducts in this tower at the same time as the surface can be used for utilisation of solar energy.
- In the heating season, the solar walls on the surface of the ventilation towers are going to preheat the fresh air before it is drawn through a heat exchanger. During the summer the solar walls can create a thermal lift power and this way driving power to natural ventilation of the flats.

Lessons learned and conclusions

- The measurements show that the efficiency of the solar collectors on the ventilation towers is good on the given conditions.
- The measurements in Lineagården have also shown that in specific building projects there are three conditions that have caused indoor air climate problems and a lower solar yield than expected:
  - The ventilation ducts were insufficiently insulated;
  - The solar towers are situated too much in the shade;
  - The heat exchanger counteracts the solar yield.
- User operated heat recovery ventilation improving the indoor air climate.

References

- Low energy housing retrofit project using solar ventilation towers, EU Thermie project SunVent, Cenergia Energy Consultants, August 2002.
- "Solenergi og Byøkologi", by Peder Vejsig, 1st edition 2002

[1] compared to Danish building standards