Havremarken (Denmark)

District heating saving: 30-40 %

Preheating of ventilation inlet air

PV modules in roof, Heat recovery ventilation using individual units

Project data

Location, address:	Finsensvej 88-96, Frederiksberg
Region:	Copenhagen
Surroundings:	Housing block area
Climate:	Continental and cold
Heating degree days:	2906
Year of construction and renovation:	1940'ies (construction); 2002 (renovation)
Typology:	Apartment
No of dwellings:	70
Total floor area:	4.000 m^2
Owner:	KAB, Frederiksberg Boligselskab
Architect and Builder:	Witraz architects; KAB, Frederiksberg Boligselskab
Costs of energy saving measures:	€ 4.000 (incl. VAT)
Renovation financed by:	KAB, EU and Danish Energy Authority

Fig. 1: Placement of the PV modules

Objectives and Results

The objective was to increase the insulation level and improve the indoor air climate.
Ventilation with heat recovering has been installed to improve the indoor air/climate and is run by the PV. The PV modules are cooled down by the fresh air which also improves the efficiency of the PV.

Renovation concept

Key renovation features

- PV system on roof
- Heat recovery ventilation system
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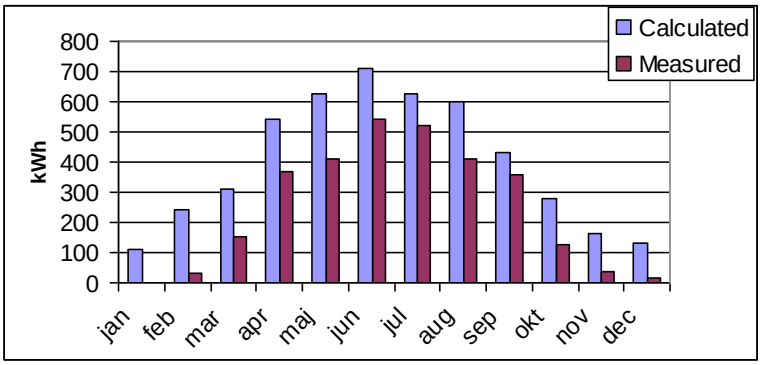
State-of-the-art

Before renovation	After renovation
Constructions [U-values: W/m²K] • Windows [2,8] • Walls [0,45-0,55] • Roof [0,4] • Basement floor [0,5-0,6] *Installations:* • District heating, radiator system with 2-pipe system with thermostatic valves	*Constructions [U-values: W/m²K]* • Windows [1,1] *Installations:* • Roof integrated PV system to match electricity consumption for ventilation use • New heat recovery ventilation system with individual heat exchanger in each apartment

Energy saving and monitoring

New heat demand	124 kWh/m²a
Specific energy savings	40 kWh/m²a
Energy savings	125.000 kWh/year
Overall district heating savings	30-40 %
CO_2-savings	24,6 t/a



Monitored electricity production from PV panels in Havremarken, 2002.

Additional information

- The fresh air is taken in from the facade and the heat exchanger is located under a new suspended ceiling in the kitchen. Exhaust air is let out by existing ventilation ducts
- Air is extracted from the kitchen and the bathroom and air from the heat exchanger is transferred to the living room and the sleeping room. There is a shaft for each apartment so the air is not mixed.
- Counter-flow heat recovery is placed above new partly-lowered ceilings in kitchens.
- About 60 m² of poly-crystalline PV panels have been installed on the ridge of the new roof, half of them facing east and half of them facing west. There are 70 apartments so this is about 0,86 m² per apartment. A total of 5,8 kWp has been installed. The principle is the same as for the other building, where the produced electricity is feed into the grid, but designed so that is will cover about 35% of the annual electricity consumption from the ventilation system. The annual production is expected to be in the order of 3.700 kWh.

Lessons learned and conclusions

- The PV modules have been efficient
- The individual heat recovery ventilation system has performed well and contributes to a much improved indoor air climate.
- Examples of tenants who are very much satisfied concerning the improved indoor air climate with decreased moisture content. Especially when old people are attached to the apartments

References

[1] Cenergia Energy Consultants: “Tagintegration af solceller med tagpapundertag og forvarmning af ventilationsluft i solceller” Energistyrelsens j.nr.: 51181/01-0013.
[2] Cenergi Energy Consultants: Synergy Package Approach for Energy Optimised Building Renovation (SynPack), EU project, proposal no. NNE 5 – 1999 – 00619.