Heat recovery ventilation system

Because of the increased demands for low-energy ventilation systems in buildings there has been a great interest in development of heat recovery with mechanical ventilation systems, where outlet air is used for preheating of inlet air. To reach a low value for energy use and especially heat consumption in a building a heat recovery ventilation system with high efficiency is necessary. E.g. a passive house can only be realised with high effective heat recovery ventilation.

Fig. Illustration of a heat recovery unit placed in connection to the ventilation system in a closet. This solution makes the maintenance easier.

Not only energy consumption is decreased by heat recovery ventilation systems with low electricity use, but also the indoor air quality is improved, which not only is a benefit for the tenants but will also prevent e.g. moisture damage in buildings.

To meet the demands for energy efficient ventilation system the following requirements should be satisfied:

- ✓ The dry efficiency of the heat recovery heat exchanger should be at least 80-90 %.
- ✓ Power consumption of the ventilation system should be only 30-40 W (0,24 $W/(m^3/h_{air\ change})$) (Danish Building Regulation demand is 87 W).
- ✓ The building should be complete air tight (natural infiltration should be 0,05 /h and never higher than 0,1 /h).
- ✓ The ventilation system should be installed inside the building envelope.
- ✓ The noise level should be less than 25 dB.

- ✓ For privately owned ventilation systems demand controlled operation f.ex. in min, mean, max as well as summer and winter is a normal demand.

In the Demohouse project, it has been aimed to develop a cost-effective heat recovery unit, with improved electricity efficiency and improved thermal efficiency in practice. In a new series of fans with backward curved blades the electricity consumption is decreased considerably from the former normal level. Also a DC engine has been developed where the electricity consumption incl. converter is 20 % below this level.

The main focus should be on individual heat recovery units for each apartment, due to risk of malfunction, more simple control and avoidance of heat losses in a cold loft room. Here there is a big need for solutions with a documented low electricity use and low noise. A solution with individual 15-25 cm thin air to air heat exchangers from the Danish company EcoVent has been developed. These can be integrated along the walls or loft in a simple way and with simple maintenance possibilities (e.g. change of filter). To make it possible to check the low electricity consumption for ventilation an easy check system for this is foreseen.

There will have to be ventilation with heat recovery if the aim is a total energy use below 65 kWh/m^2 per year for heating and hot water. In all cases a sufficient air change of 0,5 per hour shall be acquired. In case of mechanical ventilation max. 0,05 /h air change shall be through natural infiltration equal to 1,0 per hour at +/- 50 Pa blower door test.

User controlled ventilation can be 126 m^3/h or 0,5 /h at normal conditions and 65 m^3/h as a minimum value when you are away. There is a need for summer operation with a by pass function (to avoid overheating of the dwelling) and winter operation with a reduced fresh air amount when the temperature is below -5ºC (to reduce heat losses?). Relative humidity should not exceed 60 % and filtering is needed.

A reduction in energy consumption can best be obtained with a user controlled ventilation system and use of energy efficient components in optimal designed solutions. Also service and proper cleaning of the ventilation system is necessary (FK: how often?). The air velocity for ventilation shall be below 0,15 m/s in rooms to prevent draught problems for the tenants.

Technology	Relevant Indicators	Performance Requirements			Check Systems and standards
		2006 (Present situation)	Goal for next EPBD in 2011	BAT (Best Available Technology)	
Heat Recovery Ventilation with Low Electricity Use (D, PO)	Electricity consumption: (See note below) Electricity use for ventilation [Wh/m³]: Heat recovery: Volumetric current [m³/h]: Noise level: **Exhaust only,** Electricity consumption: Noise level:	800-2000 W/(m³/s) 25 W electricity use per dwelling (0,20 W/(m³/h)) 0,41 80-92 % 25-28 dB(A) 400-1000 W/(m³/s)) 28 dB(A)	200-1.200 W/(m³/s) 25 W electricity use per dwelling (0,20 W/(m³/h)) 0,39 85-95 % 25 dB(A) 100-600 W/(m³/s)) 25 dB(A)	Mech. vent.: 200-1.200 W/(m³/s) 87 W per dwelling (0,28 W/(m³/h); 0,15W/(m³/h) for small local devices) 0,26 70-99 %, 75 - 230 25 dB(A) 100-600 W/(m³/s)) 25 dB(A)	Electricity, temperature and noise monitoring. Efficiency is confirmed. VDI 2071 TZWL- European Test Centre for Heat recovery ventilation. VOB/C- DIN 18 379 (supply test) VDI 2088 VDI 2081 Electricity and noise monitoring

Note: In some cases also electricity use to avoid freezing problems. Alternatively a reduced inlet air volume can do the same. Dependant on pressure loss, here 20-300 Pa at 600-2.400 m³/h:

Exhaust		SEL low-energy	SEL normal
2.400 m³/h	300 Pa	517 J/m³	1.350 J/m³
1.500 m³/h	120 Pa	272 J/m³	1.086 J/m³
600 m³/h	20 Pa	107 J/m³	1.036 J/m³