Single family house, Øvre Hovsbakkan 61, Orkanger, Norway

PROJECT SUMMARY
Housing renovation in several stages comprising:
•Building envelope
•Ventilation and heating system
•Smart control
Reduction of delivered energy: 55 %

SPECIAL FEATURES
Improved ventilation system design

PLANNING AND DESIGN
Owner

OWNER
Dr. ing. Bjørn Jenssen Wachenfeldt

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

IEA – SHC Task 37
Advanced Housing Renovation with Solar & Conservation

Living room in the first floor before renovation

Living room in the first floor after renovation

BACKGROUND

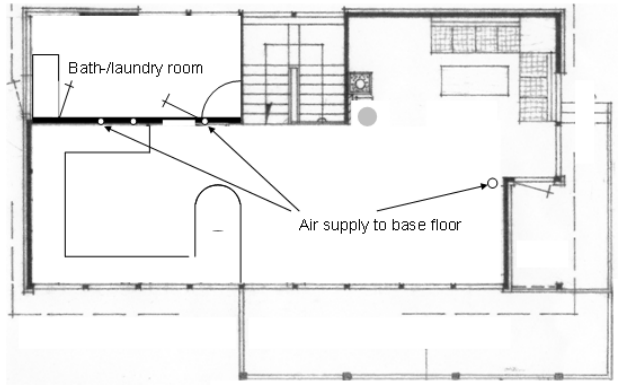
Typical two-storey house in the neighbourhood, constructed in 1981-1982 with approx. 100/150 mm mineral wool in walls/roof, electric radiators, electric floor heating and wood stove. High energy consumption and poor comfort called for a relatively comprehensive renovation. The desires were:

1. A new office and a complete renovation of the laundry room, living room and kitchen to modern standards.
2. Improved energy performance
3. Improved indoor air quality and thermal comfort.

SUMMARY OF THE RENOVATION

•New roofing installed
•Balanced ventilation system with highly efficient heat recovery installed
•All windows replaced with triple glazed windows close to passive house standard (U value~0.8-1.0)
•200 mm mineral wool added in the attic
•50 mm insulation added on the inside of the west facade and bath/laundry room walls in the 1. floor
•100/150 mm insulation added in new office
•High focus on improving air tightness
•New, highly efficient wood stove and heat pump installed, and all electric radiators removed
•Installation of smart control system (not carried out yet)

Plan view sketch for the first floor before renovation



Plan view sketch for the first floor after renovation

Living room after renovation. The transparent ventilation duct to the right provides fresh air to the office and one of the bedrooms in the base floor. A 5W LED lamp is installed within.

CONSTRUCTION (Before renovation, assumed)

Floor construction	*U-value: 0.7 W/(m²·K)*
Gravel	100 mm
Expanded polystyrene (EPS)	50 mm
Reinforced concrete	70 mm
Linoleum	3 mm
Total	223 mm

Wall construction	*U-value: 0.34 W/(m²·K)*
(interior to exterior)	
Wooden panels/pressed wallboards	15 mm
Vapour barrier	1 mm
Mineral wool	100 mm
Wind barrier	1 mm
Air	20 mm
Wood panelling	22 mm
Total	159 mm

Attic floor (roof)	*U-value: 0.34 W/(m²·K)*
(top down)	
Ventilated attic	-
Mineral wool	100-150 mm
Vapour barrier	1 mm
Air	20 mm
Wooden ceiling plates	12 mm
Total	133-183 mm

Tightening of the vapour barrier towards the attic

Sleeves (white) are used for tightening between the vapour barrier and the ventilation ducts penetrating the attic floor before insulation is added. (The sleeve to the right is not mounted yet)

Summary of U-values W/(m²·K)

	Before	After
Attic floor	0.34	0.13
Walls	0.34	0.25
Windows	2.8	0.9

VENTILATION

A balanced ventilation system with ~80 % temperature efficiency was installed. Air is supplied to the office and each of the bedrooms in the base floor. From these rooms most of the ventilation air flows through the hall and staircase up to the living room and kitchen on the first floor, and further into the first floor bathroom where the main exhaust vent is placed. Since all ventilation air is supplied via bedrooms (and office) on the ground floor, unnecessary night ventilation of the living room is avoided.

A properly sized exhaust vent is also placed directly above the wood stove in the living room. This exhaust is controlled by a damper, which is opened when the wood stove otherwise would provide to much heat to the living room. This redistributes excess heat to the first floor via the heat exchanger.

ENERGY PERFORMANCE

The heat pump together with the improved U-values eliminates the need for the previously used electrical floor heating in the base floor and electric radiators in the living room and kitchen in the first floor. After renovation it is assumed that wood covers approximately 20 %, and the heat pump 80 % of the space heating demand.

Calculated demand for total delivered energy/primary energy*:
Before: 286 kWh/m²/627 kWh/m²
After: 130 kWh/m²/260 kWh/m²
Reduction: ~55 %/59 %
* Primary energy factor for electricity and wood logs: 2.35 and 0.10

Calculated energy use for space + water heating (delivered/primary energy):
Before: 246 kWh/m²/533 kWh/m²
After: 90 kWh/m²/166 kWh/m²
Reduction: 63 %/ 69%

Calculations based on methodology from the Norwegian calculation standard NS3031:2007. The first year after renovation, the total energy demand (delivered energy) has shown to be about 100 kWh/m².

BROCHURE AUTHORS

Bjørn Wachenfeldt and Marit Thyholt, SINTEF Building and Infrastructure,
Contact person: Marit Thyholt, +4790507586
marit.thyholt@sintef.no