Skodsborgvej, Virum

Project summary

Energy concept: Total renovation to reduce energy consumption and improve indoor climate

Background for the renovation – reasons

- The double-storey detached house from 1927 is situated in Virum, 20 km north of Copenhagen. In December 2011, a small family bought the house. The family wanted to renovate the house in order to enjoy the house more in the future. Therefore, the family contacted an energy adviser who audited the house, and together they made a plan for the energy renovation of the house.
- They wanted an energy renovation because it was difficult to heat the house to a satisfactory temperature, and the house had a bad indoor climate and also they wanted a bigger bathroom in the basement. Therefore, they borrowed money to finance these renovation measures.
- As a result of the cooperation with the energy adviser, the energy renovation was given high priority, both because it would save money and provide comfort and improve the indoor air quality.

Site:	**Skodsborgvej, Virum, Denmark**
Altitude:	27 m
Heating degree days:	2906 (base temp. 17º C)
Cooling degree days:	0
Owner:	Thomas Brørup & Susanne Krøgh Rasmussen
Architect:	-
Engineer:	Susie M. Frederiksen

Contact Person:	Susie M. Frederiksen, Danish Knowledge Centre for Energy savings in buildings
Important dates:	The house was renovated in1941, 1951, 1954 December 2011: The family bought the house 2012: Renovation was planned and carried out.
Date completed:	6 January 2014

Building description /typology

- Two-storey villa with red bricks and red tiled roof, built in 1927
- Energy label G
- Gross heated floor area: 121 m^2

Figure: House seen from the road – before renovation and from the garden after renovation

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

Building envelope before renovation

The first floor had a very low level of insulation and suffered from draught, which made it quite uncomfortable during winter. For the same reasons it was almost impossible to heat the first floor to a satisfactory temperature. The mansard walls were partially insulated (ranging from 0 to 100 mm) and the roof spaces were completely uninsulated. The collar beam ceiling was insulated with 200 mm of insulation except the pediment towards the road which was insulated with only 100 mm. None of the roof spaces were insulated - neither on the wall towards the rooms nor on the floor towards the rooms of the ground floor. The front tip towards the road consisted of an uninsulated solid brick-wall. The rooms on the first floor beyond the above mentioned were insulated with cellotex.

The bathroom in the attic was insulated with 25 mm of insulation

The ground floor and gable cavity walls were already insulated with injected foam, which was often used during the 1960-70s. The insulation was surprisingly found to be intact.

The windows were replaced by a first generation of double glazing during the 80s.

Heating, ventilation, cooling and lighting systems before renovation

The house was heated with central heating from 1954 supplied from a gas boiler from the 80s. The house had no ventilation system, i.e. natural ventilation was used.

Seen from the garden before renovation

From left tp right: 1. The old gas boiler and hot.water tank. 2. Installation of the new B-labeled balcony door 3. Existing insulation in the loft

The new vapour barrier on the loft

Energy renovation features

Energy saving concept

Overall renovation in order to reduce the energy consumption and improve the indoor environment

Technologies

- Insulation of envelope
- New glazing in windows
- Solar heating plant
- Condensing gas boiler
- New valves
- New insulation of pipes
- Balanced ventilation with heat recovery

Building

U-values for constructions before/after renovation can be seen in the table.

- Ceiling - from 100 to 400 mm
- Sloping wall – from 0/25/100 mm to 200 mm
- Roof spaces in attic - from 0/25/50 mm to 300 mm
- Solid brick walls – from 0 mm to 100 mm (inside)
- Light walls and flat roof – from 25 mm to 150 mm
- Double glazed windows/doors - replaced by low energy windows/doors
- Balcony door – replaced by low energy balcony door

Systems

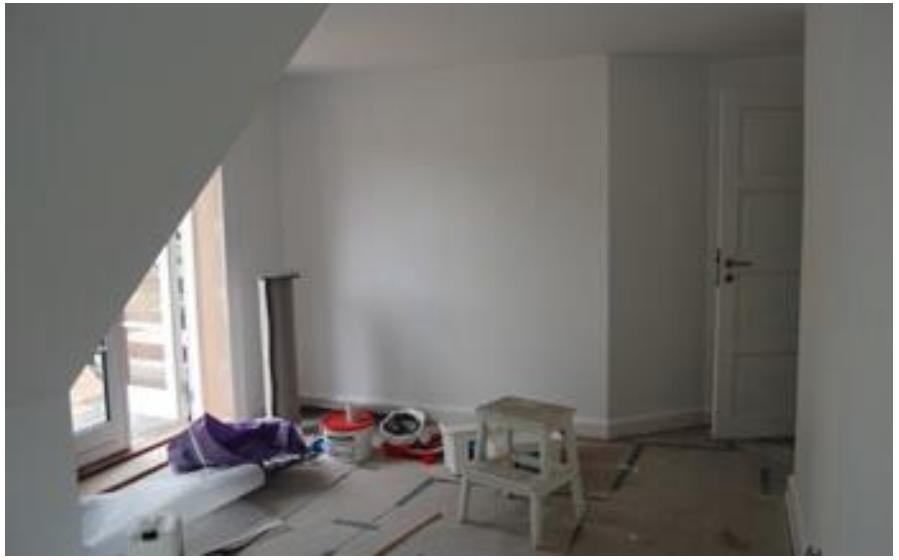
- Gas boiler – replaced by modern condensing boiler
- Radiator valves – replaced by thermostatic valves w. electronic control
- Installed weather compensation and night setback
- Insulation of hot water, heating system and other pipes from existing 0/20 mm old insulation to 40 mm new insulation

Construction	U-Value before renovation W/m²K	U-Value after renovation W/m²K
Collar beam ceiling	0,30	0,14
Sloping walls (manzard walls)	1,00	0,16
Roof spaces in attic	0,90	0,11
Solid brick walls	1,65	0,29
Light walls and flat roof	1,00	0,20
Windows and balcony door	2,80	1,40

Figure: U-values before/after renovation

Renewable energy systems

- Solar heated water - 4.7 m^2 solar panels and 300 liter solar tank



Pediment in the bedroom with new balcony door - almost ready to move in.

Calculated Energy Savings, CO_2 reductions and Life Cycle Costs

Energy consumption, calculated	Before renovation	After renovation
Energy consumption	39941 kWh (3631 m^3 gas)	21087 kWh (1917 m^3 gas)
Energy consumption pr. m^2	327 kWh/m^2	172 kWh/m^2
Useful m^2	121 (but very cold)	121 (now 1. floor is comfortable)
Energy label	G	D

Costs	DKK/EUR	DKK/m^2 / EUR/m^2
Craftsmen incl. consultants	330.000 / 44.236	2705 / 363
Subsidies (Craftsmen-deduction and from energy-utilities)	48.000 / 6.434	393 / 53
Total renovation price (after subsidies)	282.000 / 37.801	2330 / 312
Increased value of the house (due to better energy label)	306.000 / 41.018	

Calculated:
The calculated savings are approx. 18.000 kWh – which means that the energy bill is cut by approx. 47%.

User evaluation:
In the first heating season the energy bill was cut by 25% and the heated area in reality increased by 100%.

Investment and savings:
Total investment (DKK/EUR): 282.000 / 37.802
Savings pr. year (DKK/EUR): 15.000 / 2.010
Simple payback (years): 19

Energy renovation	Savings kWh/a	Reduction ton CO_2	Savings DKK/EUR pr. year
Insulation of roof spaces in attic (space under the roof slope)	1850	0.4	1450/194
Insulation of mansard walls (sloping walls) 1st floor	1800	0.4	1400/188
Replacement of glazing in windows and balcony door in the pediment	2000	0.4	1600/214
Solar heating plant for domestic hot water	2350	0.5	1850/248
Ventilation with heat recovery	4700	1.0	3700/496
Old gas boiler replaced by new condensing gas boiler	5300	1.1	4200/563
Replacement of thermostatic radiator valves to new ones with electronic control			
Insulation of domestic hot water pipes and valves	2000	0.4	1600/214
Weather compensation and night setting and balancing/ controlling of the system	2200	0.5	1750/235

Overall improvements, experiences and lessons learned

Energy

Annual savings: 18.000 kWh

Indoor environment

- No draught - no cold walls - no moisture - no mould
- No condensation on the glazing of the windows
- The air is being changed without opening the windows
- Before renovation it was not possible to heat the first floor
- Now, the house is often heated only by the passive solar energy – even in winter
- Thermostatic valves ensure that the temperature is right

. **Non-energy benefits**

- The useable space (first floor) has increased, i.e. the family will use the rooms upstairs far more
- The family can place furniture etc. close to the wall without risking damages (mould) and draught
- Improvement of energy label leads to increased house price
- This investment ensures that the family can afford other investments in the future
- The roof-construction has been checked, and it is clear that it is a good construction which will last for the next 20 – 30 years.
- Space better used (first floor)
- No draught, no cold wall, no moisture or mould
- Improvement of energy label leads to a higher possible price of the house.

Decision process – barriers that were overcome

As soon as the family bought the house, they realised that the house was not very healthy to live in – and heating it was expensive. It was so cold upstairs, that they had to wear outdoor clothing. The cold walls also meant moisture and mould. So it was an easy and quick decision, that the first floor had to be renovated with more insulation. The process started in December 2011, where the energy adviser made the first audit and made a plan for a total energy renovation; the family chose to carry out almost the entire plan.

The energy renovation was filmed to be used as a ”good example” and the energy savings were calculated by the Danish Energy authorities. In June 2012 the family could move into their new first floor – after having done the decorating themselves. The family is really happy that they chose to spend money on the energy renovation: “The new comfort is really great value for us – and we can only advise other house owners to do the same”. It was a relatively easy process for the family. They hired an energy adviser who had knowledge about both the buil-ding envelope and the technical installations and could plan the renovation and control the work process with various craftsmen. “We are really happy that we made initiated the renovation immediately – and that we took the whole energy renovation package. We no longer have doubts that this is a good house and we really enjoy living in it!”, says Thomas Baarup.

Insulation of mansard walls and lost space walls in attic incl. vapour barrier and internal insulation of the pediment

Summary and Lessons Learnt

Thomas and Susanne's new house spent a lot of energy, and they could not use the first floor as it was very cold and humid. Therefore, they contacted an energy adviser, who made a plan for the energy renovation of the house, which included as well the building envelope, heating system, ventilation and renewable energy. Susanne and Thomas chose to implement insulation of the mansard walls, and replacement of glazing in the windows and of the balcony-door. Furthermore they replaced the existing gas boiler with a new condensing boiler. A solar heating plant produces domestic hot water. A new ventilation plant with heat recovery is installed, and the pipes are insulated. Thermostatic valves are renewed, and the heating system is optimized. The family has thereby reduced the energy bill by approx. 50%, and improved indoor climate, so they can now use the entire house. The savings actually pay the loan for the renovation and the price of the house is estimated to increase just as much as the cost of the energy renovation.

Acknowledgements

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www.thomasguld.dk

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www.tritonvvs.dk

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www.murerbiksen.dk

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Ventilation Work was done By:
PRO Ventilation
www.proventilation.dk

HMN Natural Gas A / S
www.hmn.naturgas.dk/kunde/sparenergi/

References

[1] www.byggeriogenergi.dk

[2] http://www.byggeriogenergi.dk/renoveringscases/32258

[3] http://www.byggeriogenergi.dk/energirenovering-paa-film/vejledning/32435

Installation of the new heating system.

The dog Emil, Susanne, the daughter Elisabeth and Thomas enjoy their new home.