Ranica, Bergamo

Project summary

Energy concept: envelope insulation, shading devices, heating systems, mechanical ventilation, renewable energy

Background for the renovation – reasons

The intention of the owner, which was also the designer, was to refurbish his house, also addressing energy efficiency measures in order to drastically reduce energy consumptions. The provided ones have concerned:

- envelope improvement;
- new heating and DHW systems;
- mechanical ventilation system with heat recovery and geothermal pre-heat;
- renewables.

Site:	**Via Trento, 12 - 240200 Ranica, BG, Italy**
Altitude:	290 m
Heating degree days:	2486 October 15th-April 15th
Cooling degree days:	-
Owner:	Giuseppe Tebaldi
Architect:	none
Engineer	Giuseppe Tebaldi

Contact Person:	**Giuseppe Tebaldi**
Important dates:	Built in: 60s Design in: 2005 Start of works in: 2006
Date completed:	2008

Building description / typology:

— Detached single family house

— One floor over a basement (+ 2nd floor after renovation)

— Initial energy class: G (the worst based on Italian regulation)

— Gross heated floor area (after): 329 m^2

— Gross heated volume (after): 1153 m^3

View of the building before (small picture) and after renovation (large picture).

Building envelope and HVAC before the energy renovation

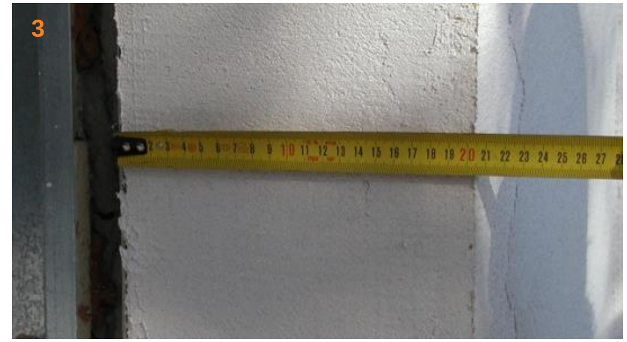
The house, is located in Ranica, a small village in the northern area of Italy. It has been built in Sixties. Before renovation, it consisted of only one heated floor over the basement (with garage, cellars etc.).

Building envelope

The vertical envelope was uninsulated, made of hollow bricks and plaster. Pitched roof with tiles was placed over a slightly insulated horizontal clay concrete slab creating an unheated loft. Windows were double glazing with aluminum frame.

HVAC before retrofit

Conventional gas heating system with radiators were installed. No mechanical ventilation and cooling system were.



Element	Area after renovation m^2	U-Value before renovation W/m^2K	U-Value after renovation W/m^2K
Façade	330	1.1	0.16-0.17
1st heated floor	160	1.25	0.17-0.28
Windows	40	3.7	1.1
Roof	160	0.7 (pitched + horiz. slabs)	0.14-0.18

1.Satellite image of the building context;
2.View of the building before renovation;
3.External walls insulation for renovation;
4.New three-glazed windows after renovation.

Energy renovation measures

Building

In order to reduce the house energy demand, the following measures have been provided:

- external insulation of walls;
- insulation of new roof and terrace;
- insulation of first heated floor;
- insulation of dumpsters;
- thermal bridge correction;
- installation of three-glazed low emissivity windows, with argon, having a PVC frame.

Storage tank.

Distribution section of mechanical ventilation system.

Plants

Building systems, after renovation, are:

- a wood stove for both space heating and DHW;
- a condensing boiler (as back-up for the wood stove);
- radiant floor panels water-based;
- mechanical ventilation system with heat recovery and geothermal pre-heat.

Energy from renewable sources

The following systems have been installed:

- solar thermal system with flat plate collectors,
- photovoltaic system.

Solar and photovoltaic panels.

System	Characteristics
Wood stove	21 kW
Condensing boiler	18 kW
Mechanical ventilation system	320 W – 85% nominal efficiency
Solar system	7.5 m^2 – 600 l tank
Photovoltaic system	4.2 kWp

Calculated Energy Savings and Costs

Energy demand for space heating:

Calculated energy demand before renovation:	275.0 kWh/m$^2_{year}$
Calculated energy demand after renovation:	13.3 kWh/m$^2_{year}$
Calculated energy saving after renovation:	261.7 kWh/m$^2_{year}$

Cost of energy efficiency measures:

Envelope improvement	k€ 53
New thermal systems	k€ 18
Total	**k€ 71**

Energy demand for space heating reduction

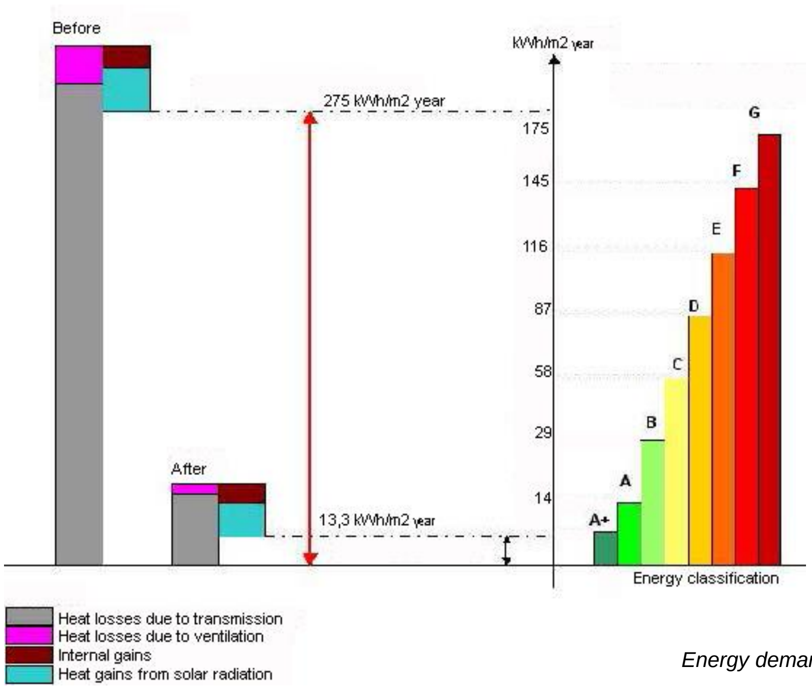
Thanks to the retrofit measures, the energy demand reduction exceeds 90% and the National energy classification passed from the worst one G to the best one A+.

Solar energy production

The solar thermal contribution is 6.5 kWh/m$^2_{year}$ while the photovoltaic one is 14.0 kWh/m$^2_{year}$.

NPV

The renovation cost has benefitted from National tax deductions (equal to 55% of investment) and the resulting payback time is 7 years (without incentive 15 years).



Energy demand before and after the renovation [kWh/m$^2_{year}$]

View of the building after renovation.

Overall improvements

Energy

- Annual thermal energy saving equals 261.7 kWh/m^2_{year} so the percentage of heating demand reduction is about 95%; the National energy classification passed by G class to A+ class;
- renewable energy sources widely provide DHW and electric need, contributing also to the space heating.

Economics

The refurbishment has purposed ambitious energy measures which have overdone the National minimum requirements with a resulting extra-cost. Nevertheless, reduction in thermal energy demand due to overall interventions (envelope and systems) would have allowed returning the investment cost within 15 years while benefitting from tax deductions has broadly shorten the pay-back time to 7 years. Moreover, thanks to the renovation, the estate value has increased with evident advantages in building market possibilities.

Non-energy benefits

The redesign of the house, implying the addition of a floor for providing also a professional office for the owner, has been the opportunity to overall renovate the building. Beside the improvement of the energy performances, several benefits have been provided: improved Mean Radiant Temperature, due to the radiant floor and the highly insulated envelope (which also influences the acoustic features), improved IAQ, due to the mechanical ventilation system, improved control of delight and of comfort mitigation in summer, due to the new shading devices, and achieved water savings, due to the installation of a rainwater recovery system for garden irrigation .

New shading devices.

View of the building during renovation.

Summary and Lessons Learnt

Summary of project
The described building is a detached single family house located in a small village in northern Italy (2486 heating degree days). Before retrofitting, it was built with an uninsulated envelope and had old thermal systems. Starting from an overall architectural building renovation, the owner/designer intended to address also energy efficiency measures in order to reduce energy consumptions and related costs. Adopted energy efficiency measures regarded: envelope insulation, windows replacement, installation of wood stove, condensing boiler, radiant floor, solar thermal and photovoltaic systems.

Experience/lessons learned
Interesting results are provided by the overall building refurbishment, which involves envelope improvement, new thermal systems and renewable energy use. High energy and costs annual savings have been reached through this intervention, allowing profitable pay-back time despite the quite relevant investment cost. Furthermore, the approach adopted for this refurbishment, based on the owner will, implied that any barriers to the process could not be observed, also considering that owner and designer coincide.

Acknowledgments
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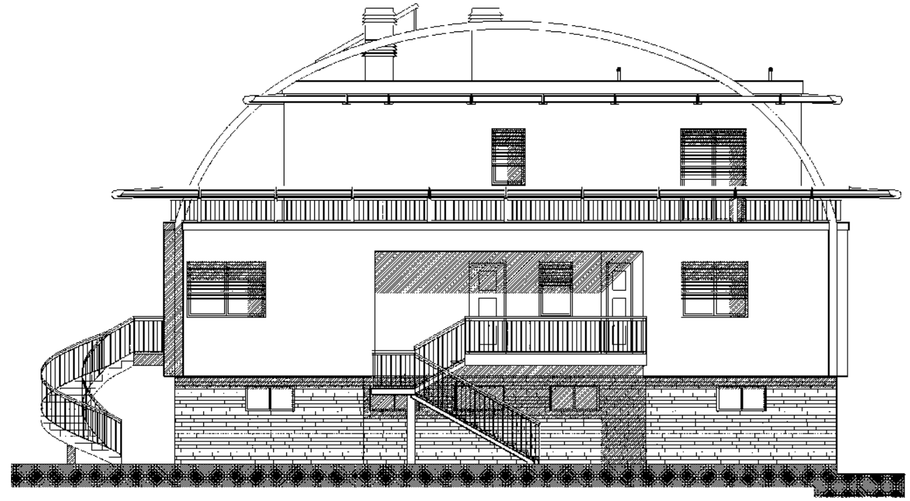
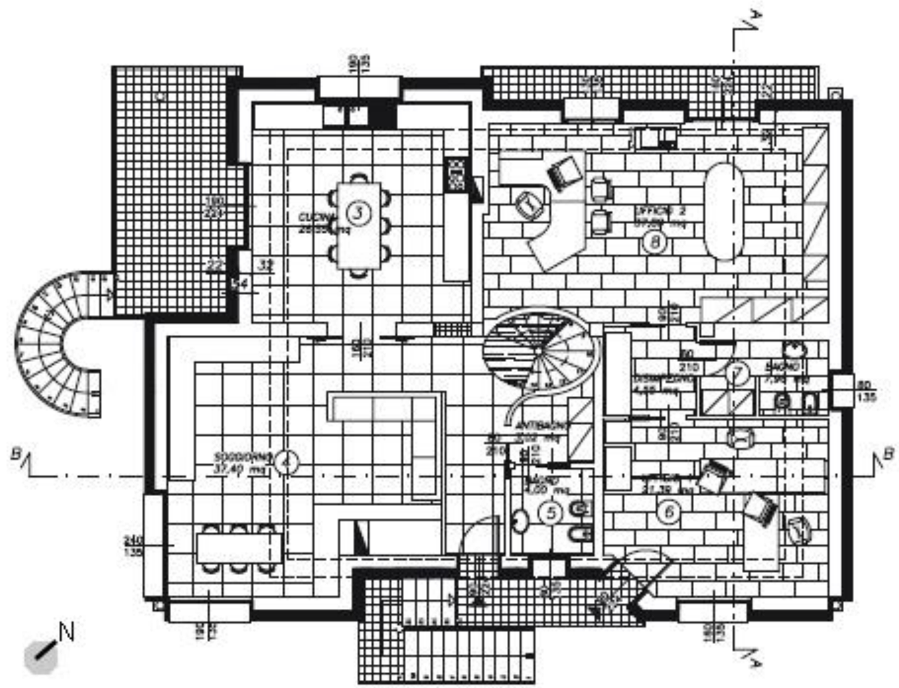
Reference:

http://www.studiotebaldi.eu



Elevation of the building.



Plan of the first floor of the building.