SFH PIAF® in Sint Pancras NL

PROJECT SUMMARY

This single family house dates from 1939 and is in almost original state. It will be renovated to reduce fossil energy demand by a factor 7 and later even become net energy positive, once the compact heat storage system (in development at ECN/TNO) has been installed in the course of timed replacement of systems.

SPECIAL FEATURES

Passive House approach, conservatory, 95 m^2 PV, 8 m^2 vacuum tube collectors. Prepared to adapt to future technological developments.

RENOVATION TEAM

Ton Kowalczyk (architect), Ruud Luitjes (contractor), Gerben Bos (Isoplan: Passivehouse elements), Jorrit Laan (Infinity NRG: PV roof), Ab de Graaff (Storkair, ventilation), Willem Koppen (real estate measurements), Wouter Borsboom (TNO), Henk Kaan, Niels Sijpheer & Martijn van Essen (ECN)

OWNERS/INITIATORS

Ivo & Sabine Opstelten

IEA – SHC Task 37

Advanced Housing Renovation with Solar & Conservation

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

BACKGROUND

This building from 1939 was purchased for its poor energy signature and improvement potential. The owner, Ivo Opstelten, wanted an enlarged living area, good indoor climate, excellent energy signature *and* improved market value in a cost-effective way. To this end he used the PIAF® methodology, namely to:

1. Anticipate the optimal combination of energy-systems in 2020 to convert the building into E-neutral.
2. Plan a new building envelope fit for the future combination of energy systems, construct it now.
3. Determine the most cost-effective combination of energy systems assuring a good indoor climate until 2020.

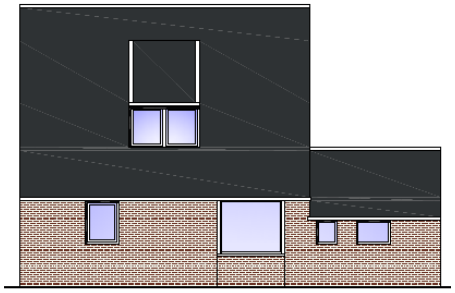
SUMMARY OF THE RENOVATION

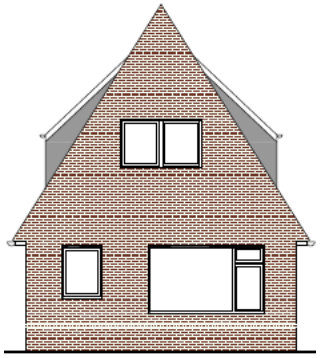
- Replacing the barn with an anlargement built with Isorast building blocks (375 mm)
- Insulation of the building envelope: roof (380 mm), facade (300 mm), beneath ground floor (200 mm)
- A new conservatory on the south side
- Adding 95 m^2 amorphous silicium PV panels and 8 m^2 vacuum tube collectors
- A new condensing boiler
- A new ventilation system (HRC 85 – 90%)
- Preparations (e.g. piping and electric fuse box) for seasonal heat storage
- Renovation of bathroom and kitchen

Total renovation costs: €150,000 (with a lot of effort by owner and friends).
Total market value increase: €200-225,000 resulting from the enlargement and energy signature (label A++) exceeding current new build dwellings (label A). The building should be compatible with new buildings of 2020.

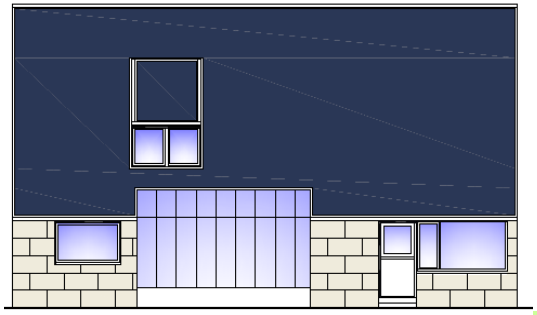
x

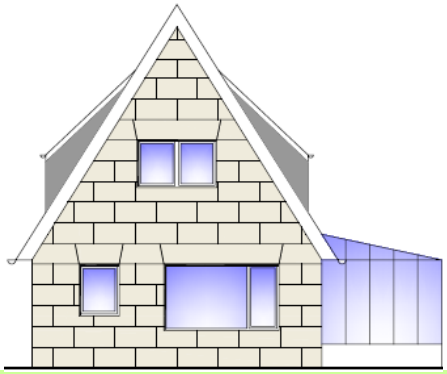
Before





After





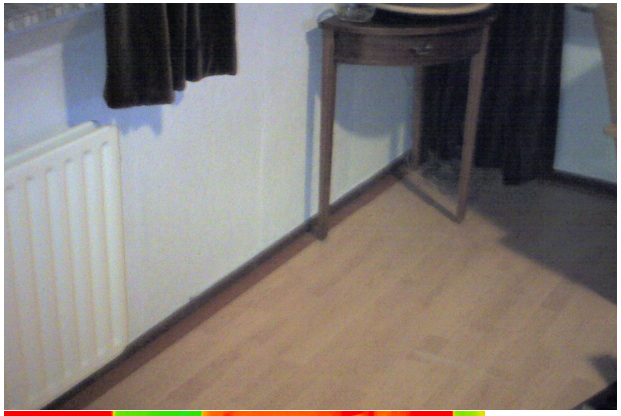
Motivation behind renovation:

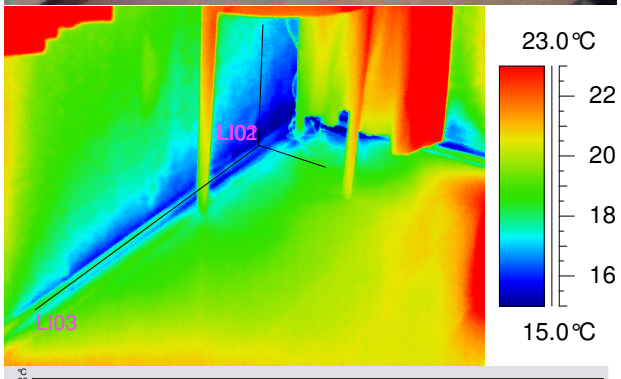
value-driven instead of cost driven

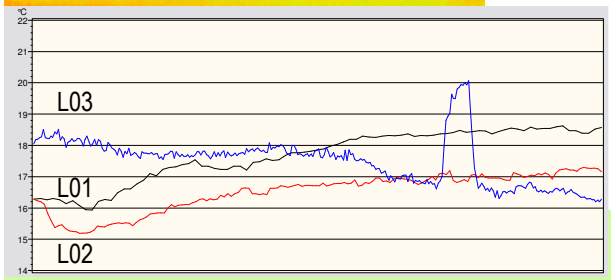
Topics to address:

- –Useless spaces (attic, barn)
- –120 m^2, 350 m^3 on 600 m^2 area
- –Draught discomfort
- –Overheating in summer, cold feet in winter
- –Too little daylighting (living room!)
- –Noise (single-pane windows)
- –Out-date bathroom (shower!)
- –Health hazard

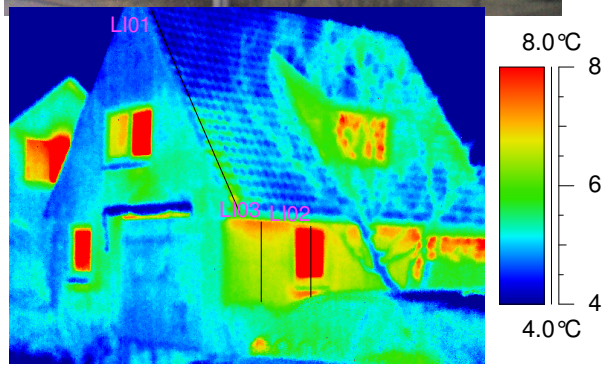
Street view with structured plaster and conservatory

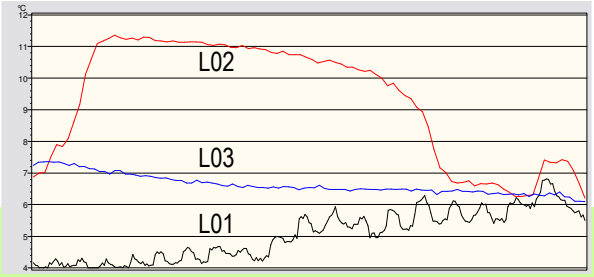






Thermography of interior wall showing effect of poor insulation, cold bridges and infiltration inside





Thermography showing poor thermal insulation and cold bridges before renovation

Thermograpical Analysis

The photos to the right of a room interior and the house exterior do not indicate any problems needing renovation.

However, thermographic images tell a different story:

The thermography image of the room wall illustrates comfort problem and mold growth / mite hazard from cold and condensation on surfaces (Pictures left).

The thermography image of the house identify exterior surfaces wtih greatest heat losses, i.e. windows, dormers, and the side walls. Unheated (unuseable) volumes are evident from the blue areas, i.e. attic (pictures right)

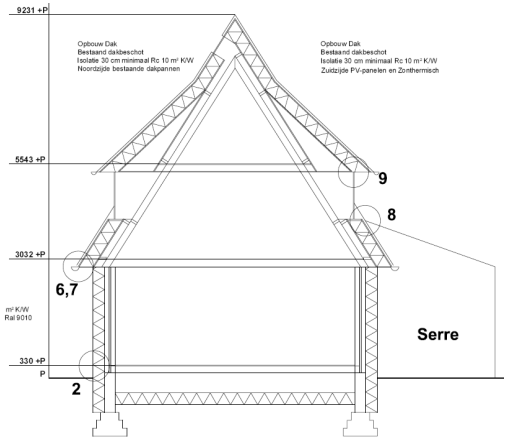
Health hazard: Exhaust vent for flue gas from kitchen gasburner directly beside dormer window.

CONSTRUCTION

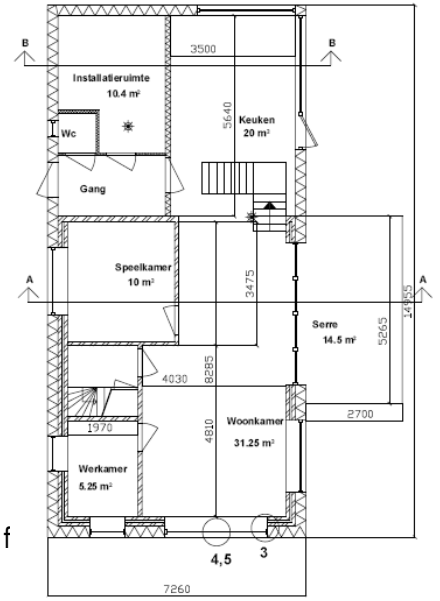
Floor construction	*U-value: 0.20 W/(m²·K)*
Poly-urethane	200 mm
Air	350 mm
Wooden floor	30 mm
Parquet flooring	4 mm
Total	234 (+350 air) mm

Wall construction (interior to exterior)	*U-value: 0.13 W/(m²·K)*
Plaster	8 mm
Brick	11 mm
Cavity	5 mm
Brick	11 mm
Poly-urethane	300 mm
Plaster	15 mm
Total	350 mm

Roof construction (top down)	*U-value: 0.10 W/(m²·K)*
Wooden ceiling plates	20 mm
EPS	380 mm
EPDM	2 mm
PV-panels (S) or roof tiles (N)	20 mm
Total	422 mm

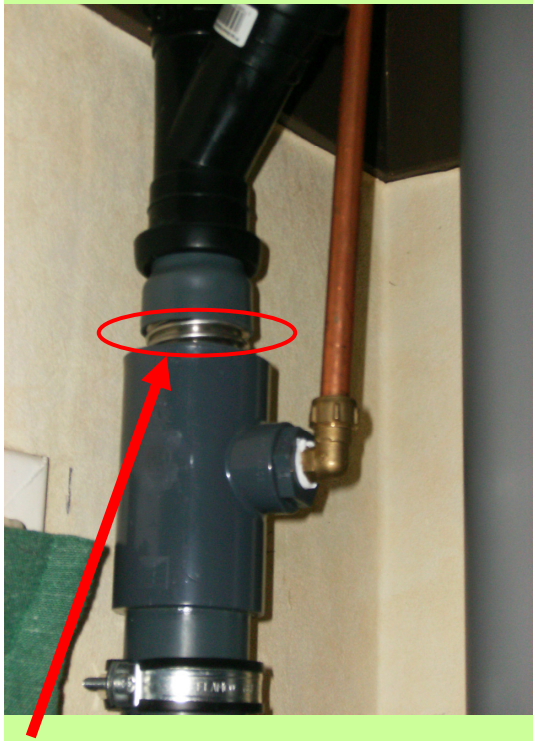


Section



Ground f

Picture showing the top part of the installed (Bries) heat recovery unit for domestic hot water (shower). The special design (ribbed 2.2 m long), ensures a high efficiency of over 70%.



Section showing part of the ribbed heat exchange area between the hot waste water running down and the cold supply water.

Summary of U-values W/(m²·K)

	Before	After
Attic roof	1.7	0.1
Walls	2.2	0.13
Floor	1.8	0.19
Windows*	3.3-5.1	1.1

Since for the windows are planned to also have external shutters, HR++ glazing was calculated to be the most cost-effective solution.

Infiltration and ventilation

Before renovation infiltration and windows provided fresh air but causing draught and large temperature gradients in winter. Result: an uncomfortable, unhealthy indoor climate.

After renovation, air tightness in combination with a balance ventilation system (with heat recovery), will ensure a comfortable and healthy indoor climate.

RENEWABLE ENERGY USE

The complete south roof slope is used to capture solar energy. This implies the installation of app. 95 m² of integrated amorphous silicium solar panels. On the adjacent garage roof, 8 m² of vacuum tube collectors will charge the 500 l heat storage tank.

To minimise the energy demand for domestic hot water a shower-water heat recovery unit is installed (see picture to the left).

ENERGY PERFORMANCE

Space + water heating (primary energy)*
Before: 275 kWh/m²
After: 40 kWh/m²
Reduction: 85%
*Standard new: 60 kWh/m²

After the renovation the PV electricity production will be 1.5 times the total household electricity demand. After 15 years the space and water heating will require no primary energy.

Brochure author

Ivo Opstelten, Netherlands