FIRST PASSIVE HOUSE IN LATVIA: PROCESS AND EXPERIENCE

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First Passive House in Latvia: a practical example
Ervins Krauklis, architect
2010
Extremely cold winter: temperatures stay below -20°C for weeks.
Passive House movement in Latvia: The Future
Passive House in Latvian cold climate

What does take conversion of ‘conventional’ (in terms of energy efficiency) building design to passive house standards without loosing the originally planned proportions and aesthetic?

Climate study

Energy calculation PHPP 2007 and dynamic simulation TRNSYS 16

Technical characteristics of building

Quality control (measurements)

Results and discussion
Typical dwelling in Latvia use from 150 to 350 kWh/(m² a) for heating. Households are one of the most energy consuming sector in Latvia - 37% [Eurostat 2007] of Latvian energy consumption.

Passive building concept is of vital importance for Latvia.

No official low energy building definition or guidelines exist in Latvia. Few studies and no real PH examples.

In 2009 the first building designed according to the passive house concept was built.
Building Type: Two storey single family house
Location: Latvia, Gipka
Year of Construction: 2009
Architect: Ervins Krauklis, “Krauklis Grende” Ltd
Mechanical System: Artūrs Gredzens, “Artiva” Ltd
Treated Floor Area: 184,4 m²
Space Heat Demand: from 15 to 27 kWh/(m²a) according worst case scenario
Ecological Measures: PV panels
Ventilation: “Paul” Thermos 300 recuperation system
Heating and hot water: “Vaillant” heat pump
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Climate study for building energy calculation

Climate is characterized by cold climate with very mild summer temperatures:

Yearly average temperature is **+6°C**

Standard heating season is **211 days**

Design temperature **-19.6°C**

Average temperature during heating season **+0.4°C**

Wind atlas Latvia, 2002

Solar atlas for Latvia, 2002
Climate study for building energy calculation

The annual available solar radiation in Gipka (building location) is between 900 and 1000 kWh/m², which is comparable with other north European cities, like Stockholm (<1000 kWh/m²), Oslo (< 900 kWh/m²) and similar to Copenhagen.
‘Conventional’ building design

Roof:
U = 0.194 W/(m²K)
Glass wool 200 mm

Windows:
U = 1.75 W/(m²K)
g = 0.7-0.8

Walls:
U = 0.291 W/(m²K)
Glass wool 150 mm

Slab on ground:
U = 0.242 W/(m²K):
foamglass insulation 700 mm
Design according to PH concept

Roof:
U = 0.068 W/(m²K)
Glass wool 600 mm

Roof:
U = 0.051 W/(m²K)
Glass wool 800 mm

Walls:
U = 0.079 W/(m²K)
Glass wool 500 mm

Slab on ground:
U = 0.1 W/(m²K): foamglass insulation 700 mm

Windows:
U = 0.8 W/(m²K)
g = 0.51
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Thermal modeling: THERM Simulator
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Connection details (example)

Thermal bridge free construction
Thermal modeling: THERM Simulator

ψ = -0.043 W/m·K
Thermal modeling: THERM Simulator

ψ = -0.084 W/m·K
Thermal modeling: THERM Simulator

ψ = 0.037 W/m·K
Thermal modeling: THERM Simulator

ψ = 0.005 W/m·K
Thermal modeling: THERM Simulator

ψ = 0.090 W/m·K
Ventilation and airtightness

Four Blower door tests:
\[ n_{50} = 0.43 \text{ h}^{-1} \text{ to } 0.7 \text{ h}^{-1}. \]
For energy calculation 0.7 h\(^{-1}\) used

Heat recovery: Paul Thermos
Total Recovery Efficiency: 89 %
Energy calculation

Space heating demand calculations

- DÄMMWERK: 15.6 kWh/(m²a), Dipi.Ing. Andreas Mermigas
- PHPP 2007: 27 kWh/(m²a)
- TRNSYS 16 simulation program: 26 kWh/(m²a)
- Peak load: 23 W/m²

- If building would be built according LBN 002-01 (Latvian building code): 127 kWh/(m²a)
- Compared with a new building of the same size and planning erected in compliance with the LBN 002-01 standard it is possible to save up to 80% of energy for heating
Peak load (TRNSYS16)

-21 °C

20 W/m²
Conclusions

- First real passive house in Latvia presents many useful and important solutions for other passive house projects in cold climates.
- First Blower door test showed very good results n50=0,43 h\(^{-1}\) during the construction process. Second Blower door test was performed and showed worse results n50=0,7h\(^{-1}\).
- The space heat consumption of Passive House “Lielkalini” during re-design process was calculated 15,6 kWh/(m\(^2\)a) and now in worst scenario, based on PHPP 2007 calculation is 27 kWh/(m\(^2\)a).
- Better (U= 0,65 W/(m\(^2\)K) windows should be developed and used in cold climates, problems have been detected with roof windows and skylights with PV cells.
- It seems unrealistic to meet required peak load (<10 W/m\(^2\)) in case of single family house with reasonable effort, based on an internal heat gains 2,1 W/m\(^2\).

- The following technical indicative properties could be used for Latvian climate
  - Walls, roof, floor < 0,08 W/(m\(^2\)K)
  - Windows < 0,65 W/(m\(^2\)K)
  - Ventilation 0,3 h\(^{-1}\)
  - Recuperation >85%;
  - Airtightness n50< 0,4 h\(^{-1}\)
  - Orientation of the building to south with maximally glazed south facade
  - Compact shape
  - Depth of window reveals be careful with unnecessarily overshaded south windows

However, calculation shows that with careful and creative knowledge-based building design it is possible to reach passive house standard in terms of energy consumption in Latvia.
Conclusions: orientation!
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Ergli Vocational School: a five-day training seminar
Renovation with PH elements
Thank You For Attention!

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