# SUBSTANTIATION OF CHOOSING ENERGY EFFICIENT HOUSE FOR LATVIAN ENVIRONMENTAL CONDITIONS

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Nowadays the high prices of energy and protection of the environment are the main reasons for improvement of house heat balance. But renovating or building energy efficient houses can mean large capital investments not available for building owners or new house builders.

In order to build energy efficient houses for Latvian environment conditions there are numerous of aspects to take into account. In Latvia the majority of local buildings used for housing of inhabitants in villages, small and large towns are family houses that are constructed before 1991. These houses are built without the respect of energy consumption for heating and ventilation. In Latvia the average heating requirement for a residential house is 193 $kWh \cdot m^{-2}$ and that is almost twice of the European average. The problems with energy un-efficient houses are not only economical or environmental, but also hygienic.

In the paper the following aspects of energy efficient house building have been covered:

1. Research on construction material availability in Latvian market;
2. Building thermal envelope calculations;
3. Humidity calculation for building elements;
4. Thermal bridge simulations for main joints of the construction;
5. Calculation and selection of the heating system;
6. Calculation and selection of the ventilation system;
7. Substantiation of the economic benefit of the project.

The plan of the house was designed in a way that there would be short lengths of ventilations and heating pipes. This also ensures small dynamic pressures in the system, so the needed power for ensuring nominal parameters is smaller than for average systems of this capacity. A house is designed for a family of 4 people, two children and 2 adults.

The walls, roof and floor are designed in order to be heat and air tight. All of the calculations were conducted adopting that air permeability of the house is 0.6 $m^3 \cdot h^{-1}$. ISO 6946 was used for all thermal calculations of the house envelope. The following U values were obtained: wall — 0.117, floor — 0.102, roof — 0.112, window glassing — 0.49 and window frame — 0.61.

Thermal bridge simulation was used to determine the thermal properties of the following structural joints of the house: window installation, wall to wall, wall to roof and wall to floor. The thermal bridge simulations were conducted using the finite element analysis program Therm 6.3 and according to ISO 10211. As discovered, the lowest temperature inside the house at thermal bridge points was 17 $C^{\circ}$ at outside temperature of 20 $C^{\circ}$, so there is no danger of condensation at winter.

Humidity analysis for the house constructions was conducted using LVS EN ISO 13788. Calculations were conducted for the roof, walls and floor. The calculated heating power for the house is 3.4kW and the annual heat loss is 6337kWh $(m^2a)^{-1}$. There are140 $m^3 \cdot h^{-1}$ of air needed for the ventilation system in order to sustain comfortable environment in the building.

The results showed that by accurate planning there can be energy efficient houses built in Latvia. A house built using the plans and systems described in this paper would only need Ls 127 for heating every year and the house would be only 8% more expensive than an ordinary house.

**References**


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