Companies and institutions participating in creation of testing ground:

Location of the test buildings at University of Latvia's Botanical Garden (Kandavas Str. 2, Rīga)

More information on the research and obtained results: www.eem.lv.

IEGULDĪJUMS TAVĀ NĀKOTNĒ

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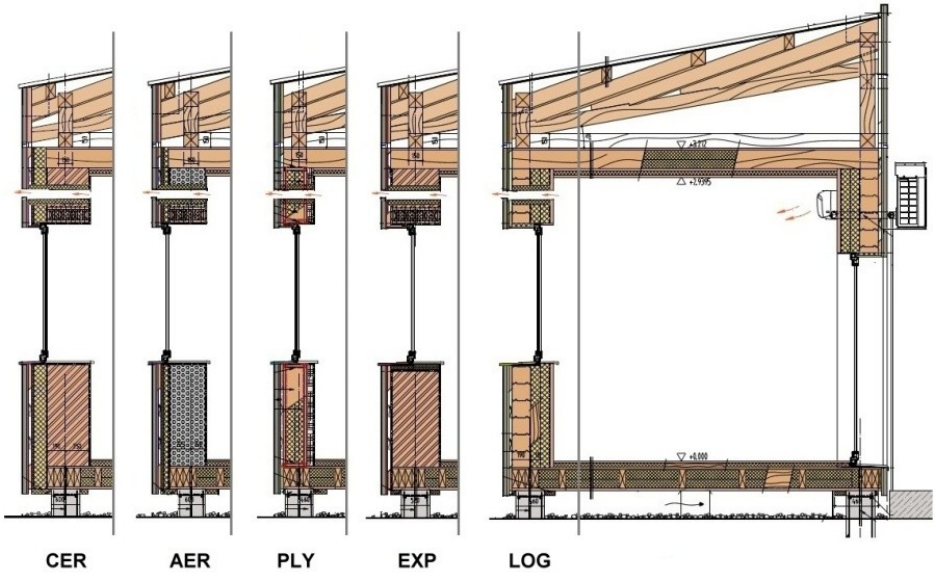
UNIVERSITY OF LATVIA
Faculty of Physics and Mathematics
Laboratory for Mathematical Modelling of
Environmental and Technological Processes

Energy efficiency, sustainability of building construction and thermal comfort in Latvian climate conditions



The 2010/31/EU Directive of the European Parliament and of the Council on the energy performance of buildings sets the objective of transition to nearly zero-energy consumption in newly built buildings and broad usage of renewable energy resources. Energy efficient solutions are needed for Latvian climate conditions and the normative documents have to be improved.

Objective of the research

To test the energy efficiency and sustainability of different building constructions made from local materials in Latvian climate conditions, at the same time ensuring thermal comfort.

Different Building Construction Types

The external wall constructions are crucially different, but their calculated thermal conductivity is the same ($U \approx 0{,}15\ldots0{,}16$ W/m^{2}K):

- logs with an internal rock wool insulation and wooden planks' interior finish (LOG);
- plywood panels filled with elastic rock wool and internal fibrolite layer (PLY);
- ceramic blocks with an external elastic rock wool insulation (CER);
- aerated concrete blocks with an external elastic rock wool insulation (AER);
- experimental ceramic blocks filled with insulation granules (EXP).

The Same Building Constructions

- dimensions (3×3×3 m) and orientation; window in south façade, door in north façade;
- ventilated underground and slightly ventilated loft with blowing birch wool fibre insulation (U = 0,16 W/m^{2}K);
- triple pane windows (U_W = 0,72 W/m^{2}K) and doors (U_W = 0,82 W/m^{2}K);
- heating, cooling and ventilation regimes, provided by air heat pumps.

Measured characteristics

- Thermal insulation and sealing condition of building constructions (thermography);
- airtightness at 50 Pa pressure difference;
- power and energy consumption for heating, cooling and ventilation;
- temperatures and humidity in different room's zones and in constructions;
- air flow speeds and air exchange rate for different regimes;
- actual heat transmittance *U;*
- intensity of solar radiation inside the window, basic meteorological data.

Causes of differences

The differences in energy consumption and thermal comfort from the predicted values are mainly determined by:

- transition processes after construction and in the process of aging;
- changes in moisture content in construction for different seasons in Latvian climate;
- different thermal inertia of building constructions (various weights and materials);
- different thermal bridges at junction points.

Main results

- Evaluation of factors influencing the monthly, seasonal and yearly energy consumption for heating, cooling and ventilation;
- evaluation of transient processes related to thermal inertia of building constructions;
- analysis of the impact of building construction humidity dynamics on their heat conductivity;
- research of transition (aging) processes in constructions after the building is finished;
- analysis of the deviations from the thermal comfort in a room;
- comparison of the differences, pros and cons of the constructions for different seasons;
- air heat pump and triple pane windows' efficiency evaluation in Latvian climate.

Usage of results

- Recommendations for implementation of 2010/31/EU Directive in Latvia;
- proposals for improvement of Latvian normative documents;
- conclusions about energy efficient building from sustainable constructions in Latvia;
- recommendations for thermal comfort improvement in low energy buildings.