Working towards safer solutions for internal insulation in cold climate – overview of the ongoing research

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INTERREG IV - Baltic Sea Region

CO_2OL Bricks

Climate Change, Cultural Heritage & Energy Efficient Monuments

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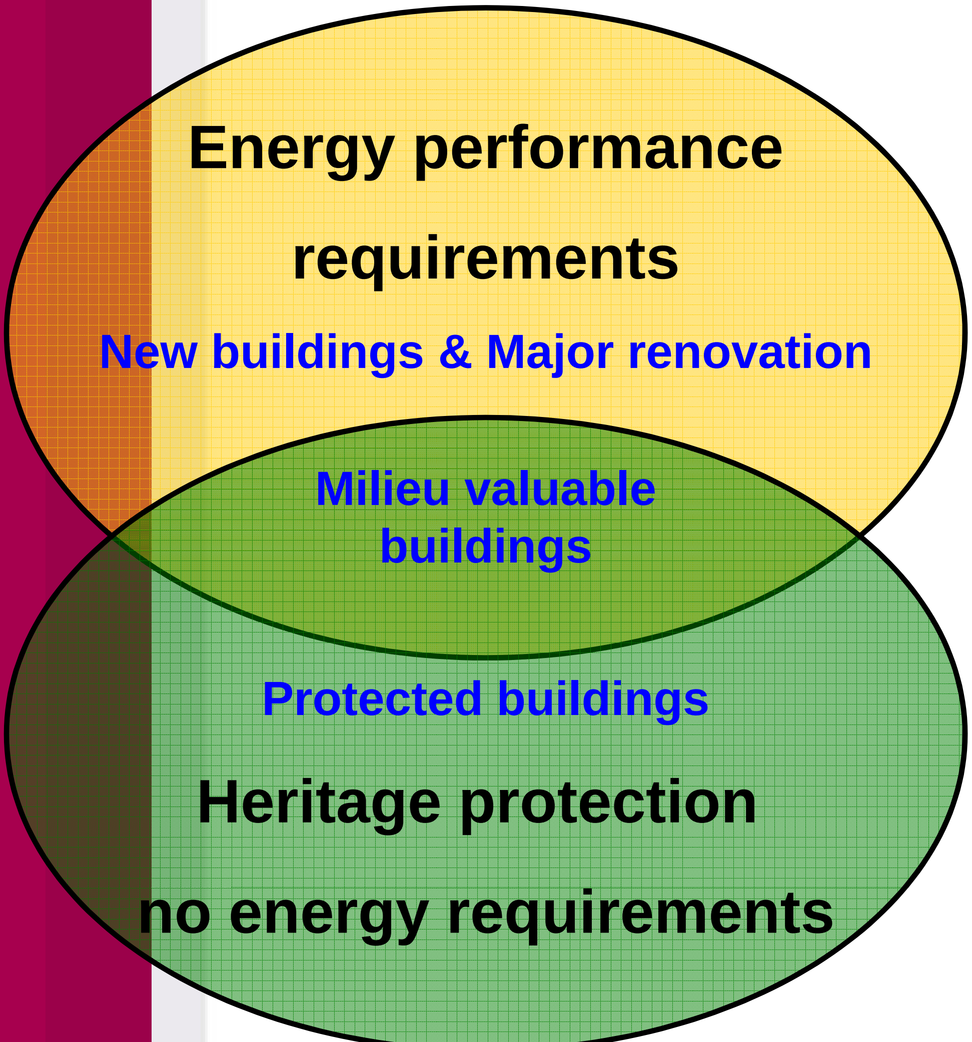
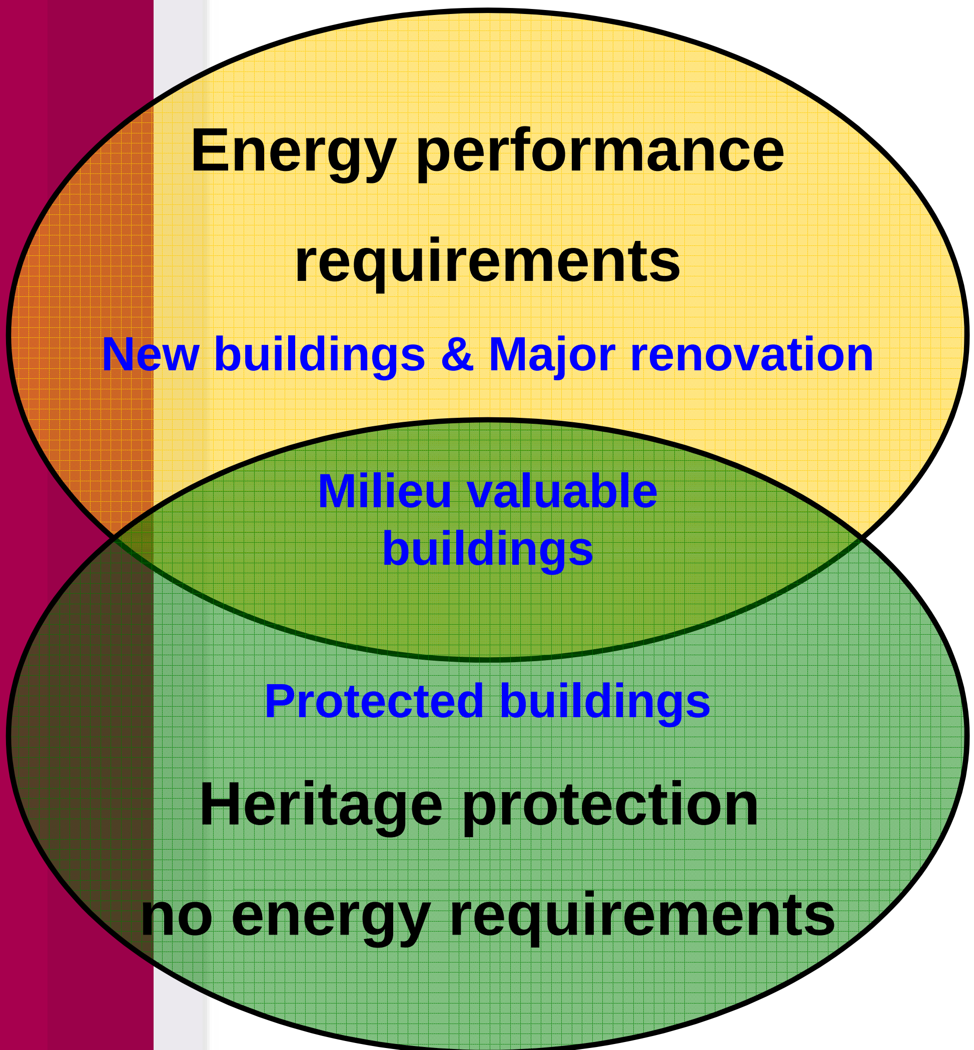
Internal thermal insulation



Internal thermal insulation

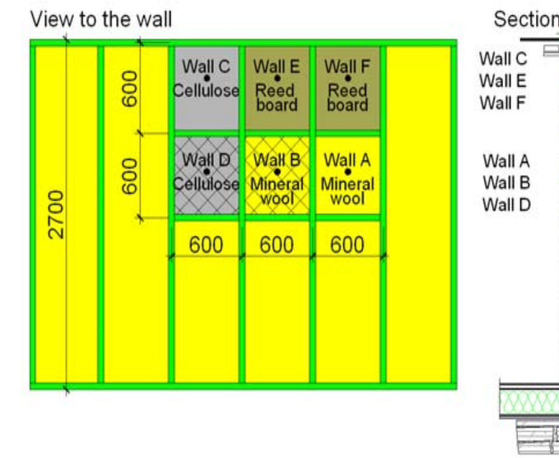


Milieu valuable buildings:

- need to lower the living costs for inhabitants
- need to preserv the cultural heritage
- more strict design demands
  - outlook of the building can not be changed (milieu valuable areas)
  - pressure to use internal thermal insulation
- risky solution in cold climate

Previous study

- Studied wooden apartment building
  - built in the beginning of 20th century
  - original external wall: 140 mm log
- Studied test walls
  - 3 different insulation mat.
    - mineral wool
    - cellulose
    - reed board
  - 6 different wall solutions:
    with and without air/vapour barrier (bitumenpaper)
  - finishing
    - gypsum board
    - render

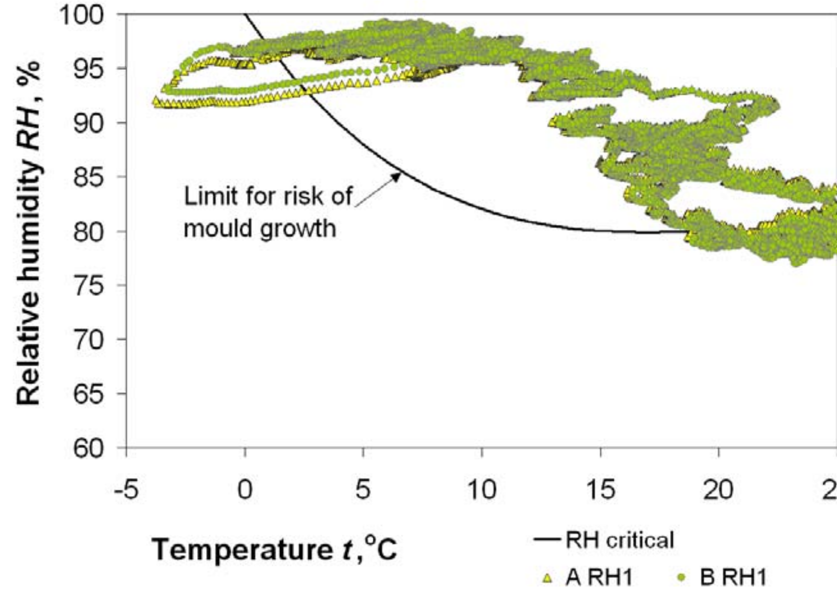


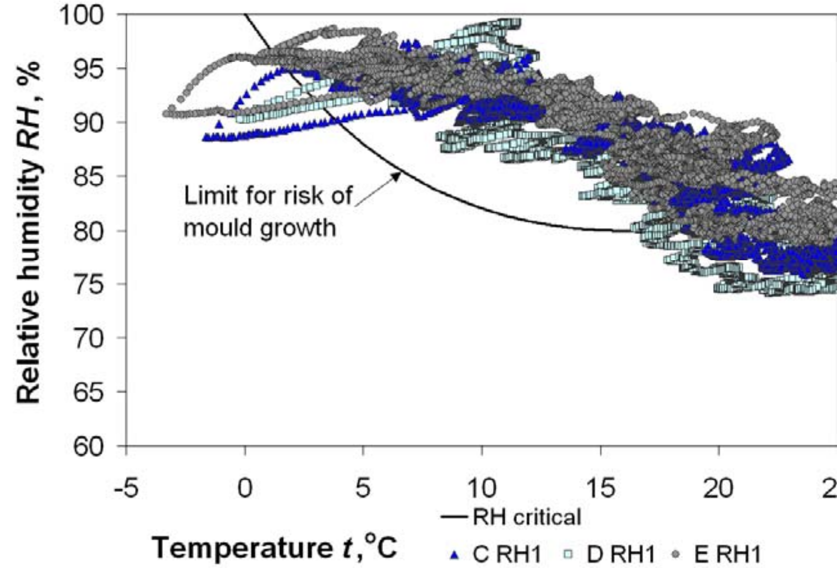
Previous study

- Risk of mould growth:

  in all the cases the T and RH level inside the wall exceeded the t and RH conditions favouring initiation of mould growth

  - mineral wool 88% of the time
  - cellulose 84% of the time
  - reed board 93% of the time





Current study: historic school building

- Built: 1938-1939 (brick building)
- Monument since 1998
- Current use:
  - Centre for work exercise
  - Hostel
  - Gymnasium

Objectives of this study

- Analysis of the hygrothermal performance of an internally insulated exterior wall
- Comparison of four different insulation materials in terms of hygrothermal performance:
  - Calcium Silicate (i.e. Calsitherm Klimaplatte)
  - Autoclaved aerated concrete (i.e. Ytong Multipor)
  - Polyurethane foam board with gypsum board (i.e. SPU Anselmi)
  - Polyurethane foam board with capillary active channels (i.e. Remmers iQ-Therm)
- Computational analysis of the hygrothermal performance of the insulated exterior walls to clarify the suitability of various solutions to different climatic loads.
- Finding suitable solutions for interior insulation which are safer (indicators can be: condensation of water vapour, mold growth, frost resistance of brick, etc.) and easier to implement than current solutions in Estonian climate.

Description of the test setup

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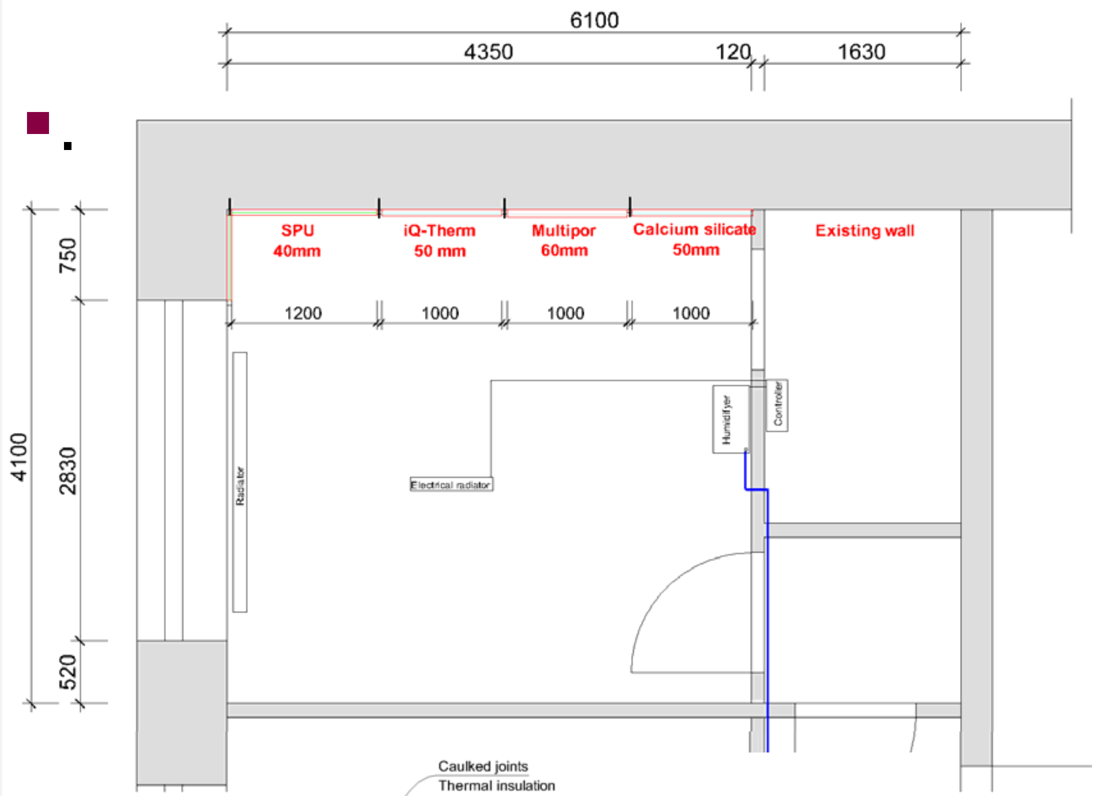

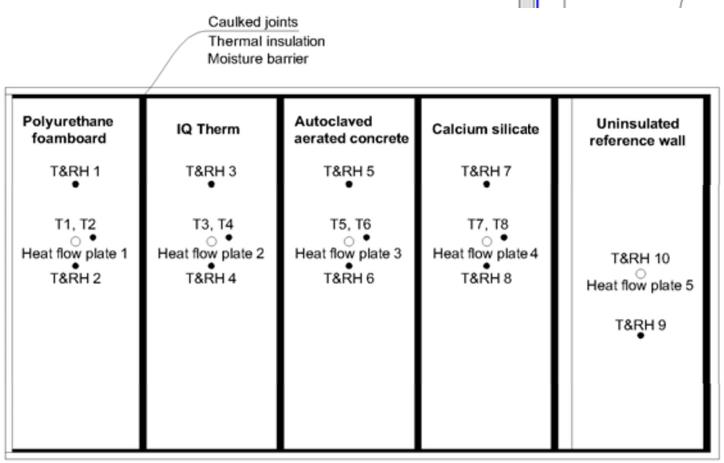

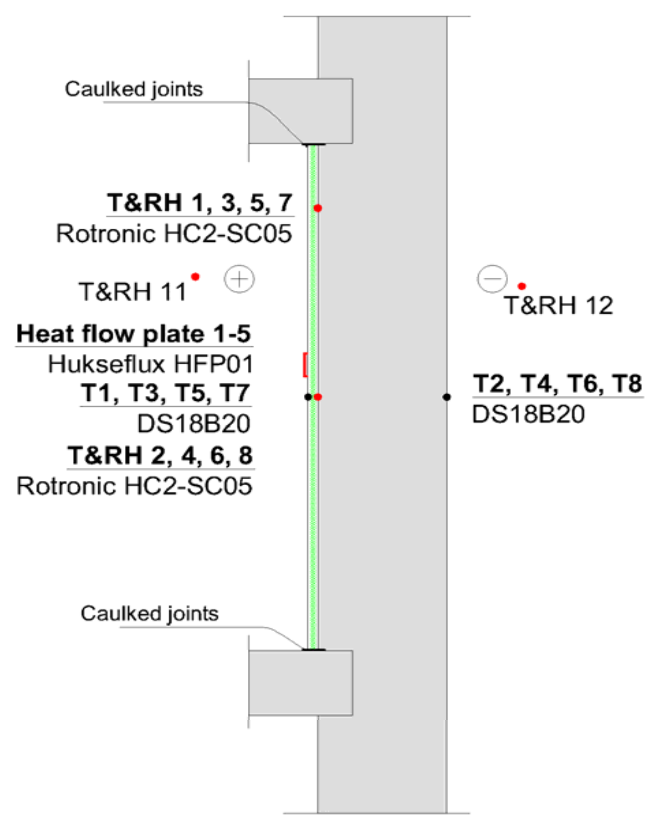

Description of the test setup

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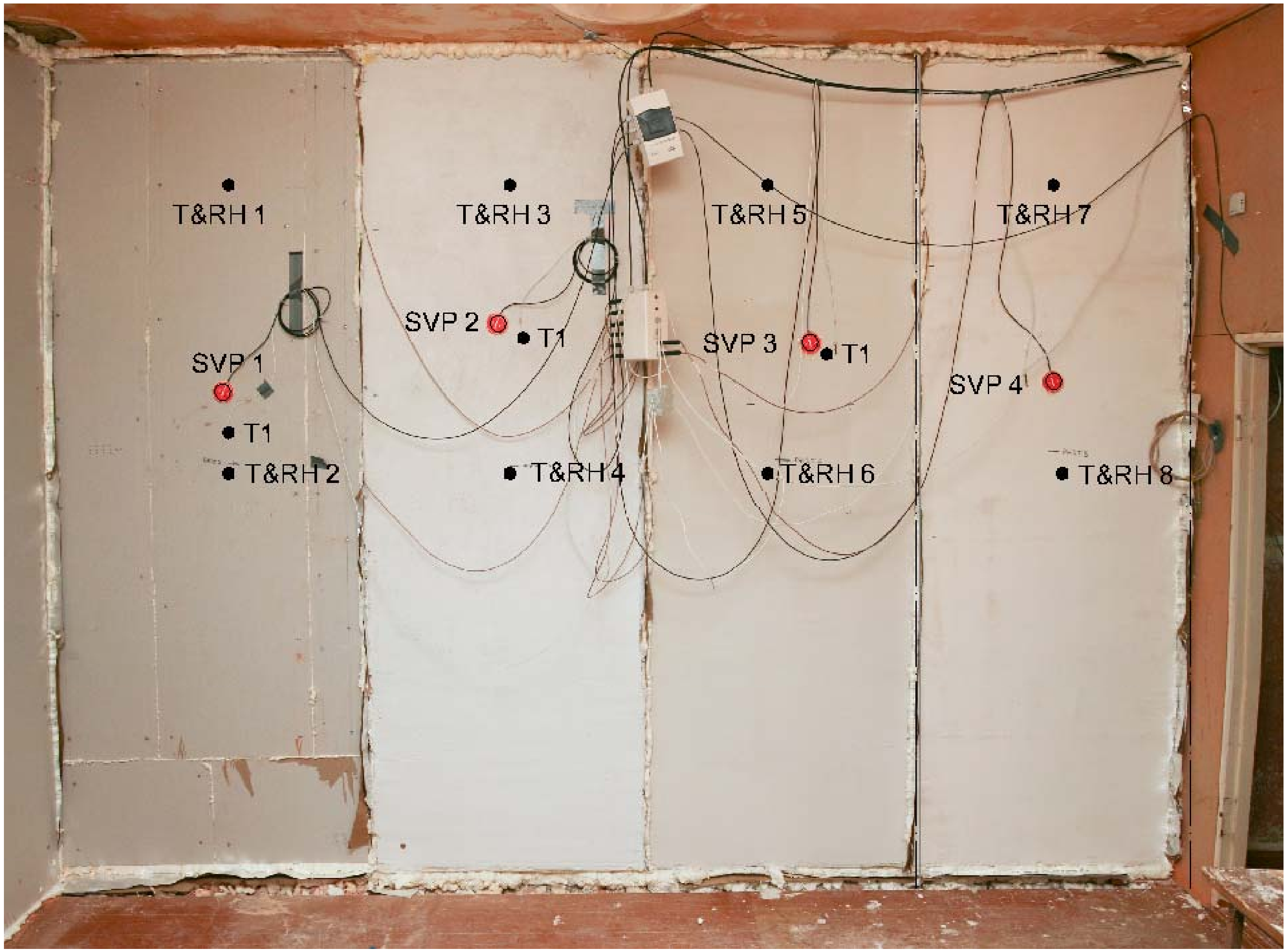
PUR with gypsum board 40 mm U = 0.36 W/m²K	PUR with capillary active channels 50 mm U = 0.3 W/m²K	Autoclaved aerated concrete 60 mm U = 0.33 W/m²K	Calcium silicate 50 mm U = 0.41 W/m²K



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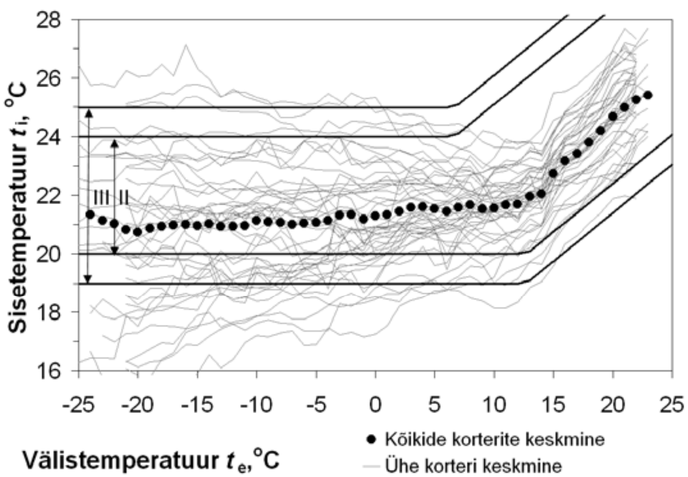
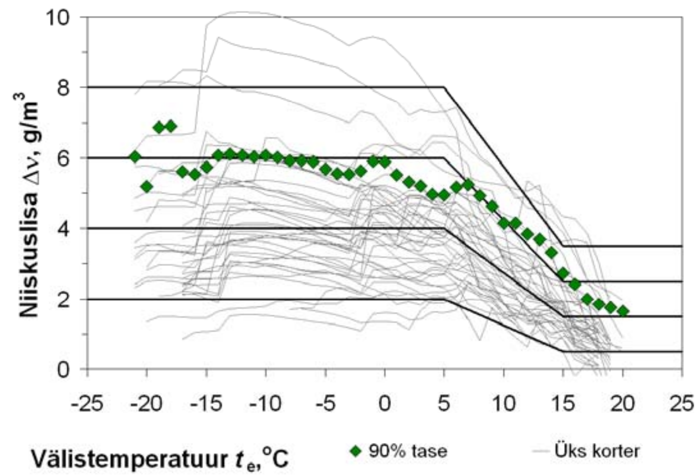




Kütmise juhtimise skeem

Näiteks taotluslik temperatuur +20°C

t_i <19,5 küte sees (+19,5: etteantav juhtarv)

t_i >20,5 küte väljas (+20,5: etteantav juhtarv)

Mida niisutuse juhtimise "must kast" teeb?

$RH_i = f(t_e)$ Juhtfunkts. | - arvutab taotlusliku RH_{i*} vastavalt t_e

t_e Mõõdetakse | Kui RH_{i*} < RH_i, siis niisutus sisse ja hoitakse seda RH_i taset 1h jooksul Järgmine tund uus tase jne.

RH_i Mõõdetakse

on/off Juhib niisutit

Niisutuse juhtimise skeem

Näiteks taotluslik siseõhu ja välisõhu veeaurusisalduse erinevus +4g/m³

RH_e t_e ν_e $\Delta\nu$ ν_i t_i $\nu_{i,sat}$ RH_{i*} RH_i

Mõõdetakse

Arvutatakse

Niiskuslisa +4g/m³ etteantav juhtarv

Arvutatakse

$\nu_i = \nu_e + \Delta\nu$

Mõõdetakse

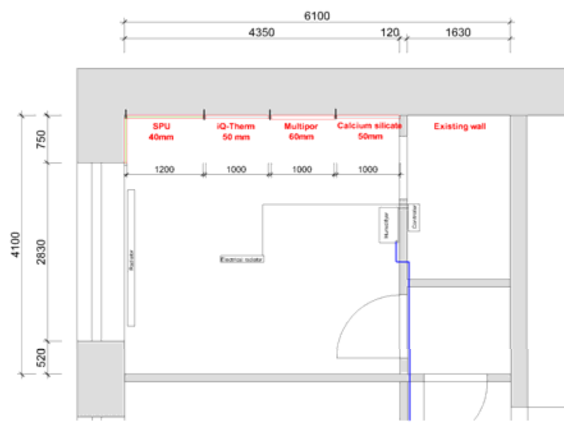
Arvutatakse

Taotluslik RH_{i*}

$RH_{i*} = 100 \cdot \nu_{sat} / \nu_i$

Mõõdetakse

Kui RH_{i*} < RH_i, siis niisutus sisse ja hoitakse seda RH_i taset 1h jooksul Järgmine tund uus tase jne.



Next steps

- Analysis of the measured data
- Calibration of the computational model
- Analysis of 2D and 3D joints/details
- Analysis of the impact of different climatic loads Assessment of possible risks caused by changes to material properties, climate etc
- Analysis of energy performance of different solutions