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Energy efficiency of historic brick buildings in Riga

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Baltic Sea Region Programme 2007-2013
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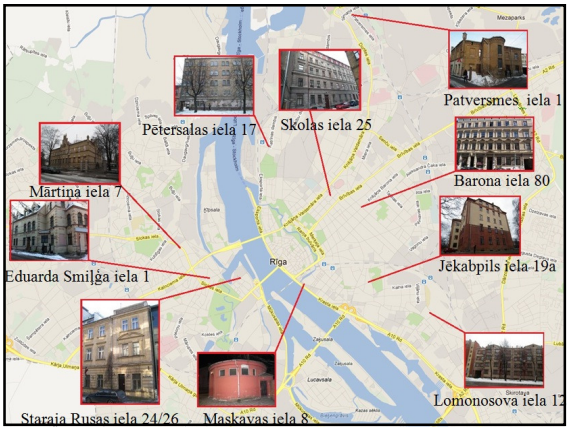
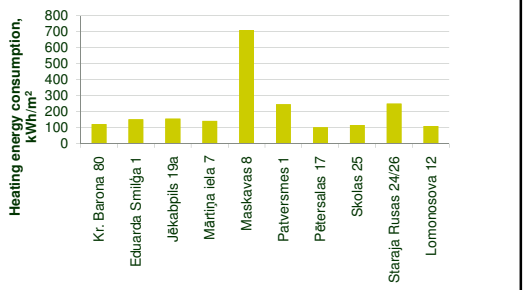
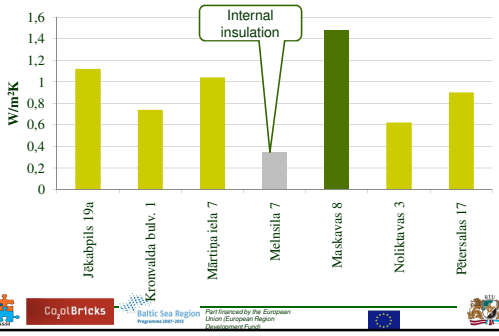


Energy consumption

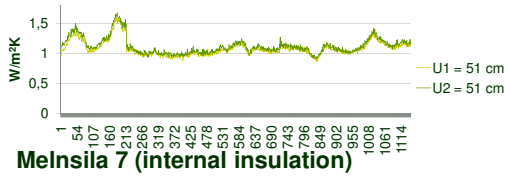


HEAT FLOW MEASUREMENTS

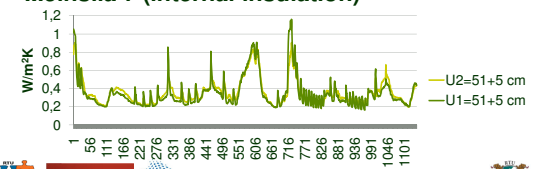
U value



Mārtiņa 7



Melnsila 7 (internal insulation)



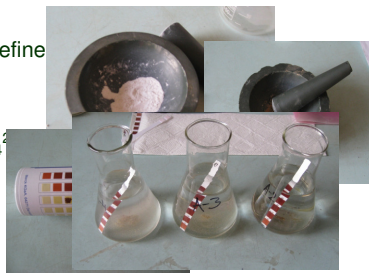
CONDITION APPRAISAL OF HISTORIC BRICK MASONRY

Deterioration of historic brick masonry

- Roof and gutters damages
- Freeze-thaw cycles
- Soluble salts crystallization
- Air pollution (CO_2, SO_x, NO_x, soots)
- High groundwater
- Poor mortar
- Acid rains

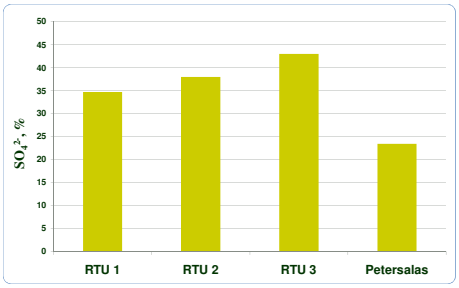
Water soluble salts

Qualitaty was define
- chlorides Cl^-
- nitrates NO_3^-
- sulphates SO_4^{2-}



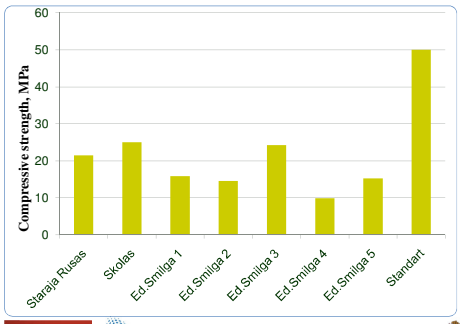
Testing method is based on methods developed by International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM)

Water soluble salts



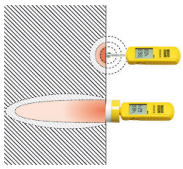
Compressive strength

Compressive strength



Determination of moisture

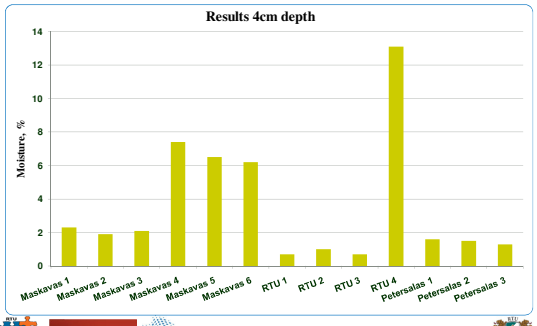
Non-destructive method



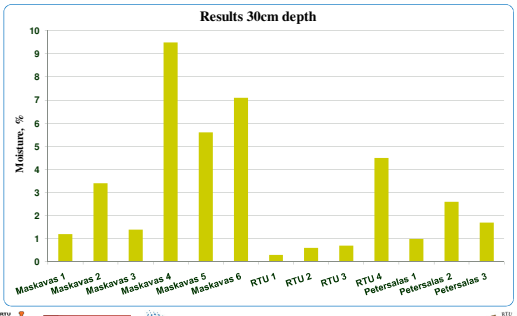
www.trotec.de/en/product-catalog

Destructive method

Determination of moisture



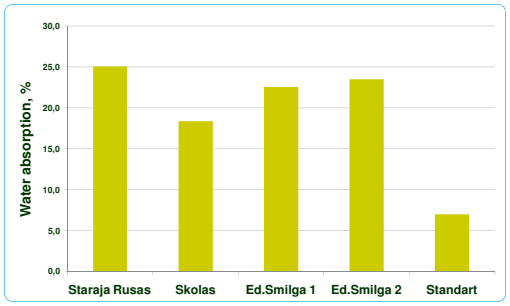
Determination of moisture



Water absorption

LVS EN 772-21:2011 "Methods of test for masonry units - Part 21: Determination of water absorption of clay and calcium silicate masonry units by cold water absorption"

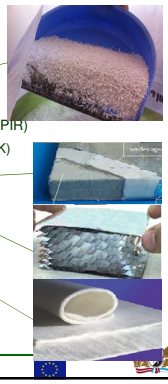
Water absorption



ENERGY EFFICIENCY MEASURES

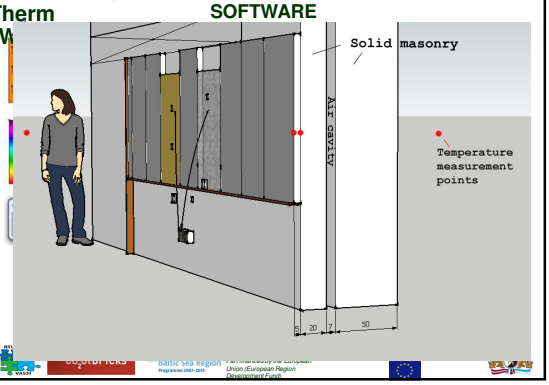
Insulation materials

- Traditional λ=30 – 50 mW/(mK)
  - **Mineral wool**
  - **Expanded polystyrene (EPS)**
  - Extruded polystyrene (XPS)
  - Cellulose
  - **Perlite**
  - Polyurethane (PUR) and polyisocyanurate (PIR)
- Latest insulation materials λ<30 mW/(mK)
  - Vacuum insulation panels (VIP)
  - Gas filled panels (GFP)
  - **Aerogel**
- Future materials λ<5 mW/(mK)
  - VIP and GFP with closed pores
  - Nano-insulation materials
  - Dynamic insulation materials (DIM)



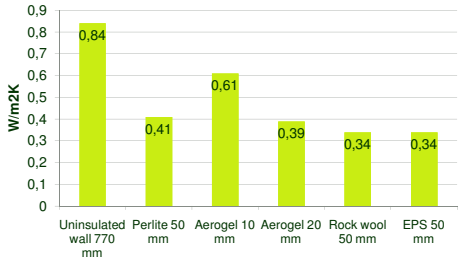
Experiment in Rigas Technical University:

Therm
SOFTWARE



- Measurments of U - value

Measured U values



[Perfomed according ISO 9869 standard]

Slide 21

M1 atvērtas vai slēgtas poras <40 nm

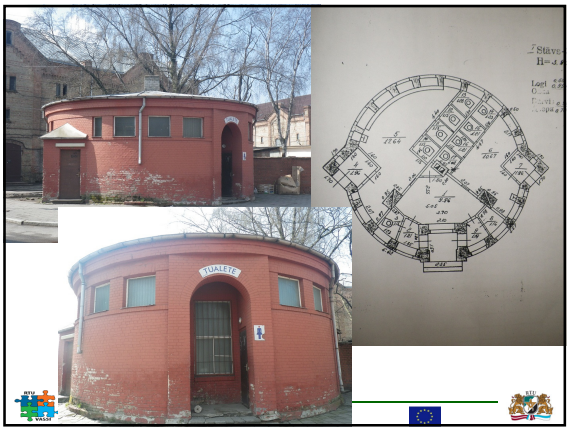
regulējot - poru gāzu koncentrāciju vai saturu
- poru iekšējās virsmas emisivitāti
- regulējot cietās fāzes siltumvadītspēju

Michels; 19.04.2012

PILOT PROJECT

Existing situation

- Built in 1930
- Silicate bricks
- Listed on UNESCO World Heritage
- Annual heat energy consumption (calculated) ~670 kW/m^2
- U value: 1.48 W/m^{2}K
- Odour problems
- Brick deterioration



Planned activities

- Internal insulation: aerogel mat, PIR, aerogel granules, vacuum insulation panels
- Windows: Tripple glazing+foil blinds+double glazing
- Daylight solution with optic fibers
- Mechanical ventilation with heat recovery
- Lotusan for external painting
- Odour removal

Conclusions

- Heating consumption:101 … 246 kWh/m^2 year
- U values of brick walls: 0.35 …1.48 W/m^{2}K
- SO_4^{2-} salts content does not exceed 42% and does not cause disruptive effect in RTU basement
- Brick strength: 9.94 … 25.08 MPa (existing standart 50 MPa).
- Moisture levels: 0.3 … 13.1%, but max values for water absorption are from 18.4 to 25.1% (existing standart 7%)
- Condition of historic brick masonry is satisfactory

Conclusions

- U-values for internal insulation (without insulation U-value 0.84 W/m^{2}K) with:
  - mineral wool (50 mm): 0.34 W/m^{2}K
  - perlite (50 mm): 0.41 W/m^{2}K
  - aerogel (20 mm): 0.39 W/m^{2}K
  - EPS (50 mm): 0.34 W/m^{2}K
- Planned energy consumption for pilot project is 130 kWh/m^2 year