Rehabilitation of basement walls with moisture problems by the use of vapour open exterior thermal insulation

Stig Geving (prof.), Norwegian University of Science and Technology (NTNU)
Marius Kvalvik (M.Sc.), SINTEF Building and Infrastructure
Espen Martinsen (M.Sc.)
Background

• Many methods for rehabilitation of moisture damaged basement walls
• Traditional method:
  – Renew drainage system + new moisture membrane (+ external insulation (typical EPS))
  – Robust method, BUT all existing moisture has to dry to the interior
  – May take very long time before wall is dry
Background

- **Alternative method:**
  - Renew drainage system + external vapour open insulation
  - May allow existing moisture to dry both inwards AND outwards
  - Rising damp may also dry outwards
  - Materials:
    - Hard rockwool
    - Special products (glued EPS pellets)

- **Purpose:**
  - analyze drying speed with alternative method compared to traditional method
Hygrothermal simulations

- **WUFI 2D**
  - vapour diffusion + capillary conduction

- **Reference basement wall**
  - 200 mm B15 concrete
  - 100 mm vapour open external EPS ($\mu = 4$)
• Boundary conditions:
  – Indoor:
    • 22 °C
    • RH from measured moisture supply $\Delta v$
    • $\Delta v = 2.2 \text{ g/m}^3$ (winter), 0.5 g/m$^3$ (summer)
  – Outdoor,
    • above ground: Oslo
    • RH below ground: 98%
    • T, below ground:
      – Used HEAT 2 to calculate sinus-curves for different depths

• Initial conditions:
  • Pre-simulations with WUFI without external membrane/insulation
    • RHground = 100-97 %
    • Indoor: 10 °C/ 80%
Parameter variation

- Vapour permeability insulation
- Thickness of insulation
- Indoor temperature
- Build-up/insulation on interior side
- Other wall material
- Bottom of wall in contact with water
- Insulation above ground
Results

1. Jan, After 1 year simulation (two cases)

Ref: vapour open insulation vapour tight insulation
Reference wall (No. 1) - Vapour open insulation

RH for two heights and four different depths.

\[ H = 100 \text{ mm} \]

\[ H = 1000 \text{ mm} \]
Effect of various vapour permeability of insulation

RH for $H = 100$ mm and two different depths.

![Graphs showing RH (%)]

- $d = 25$ mm
- $d = 175$ mm

Ordinary EPS
- $\mu = 50$

Open EPS
- $\mu = 4.4$

Hard rockwool
- $\mu = 2$
Some influencing factors

- Indoor temperature:
  - Unheated: very little effect
  - Extra warm: increased effect
  - Note: Method is based on temperature difference over the insulation !!!

- Thicker insulation
  - 200 mm gives slower drying
  - Increased temperature difference, BUT doubled vapour resistance

- Interior insulation + board material:
  - Very reduced drying
  - Total drying less than with vapour tight EPS and nothing on interior side

- Ordinary EPS give practically no drying to the exterior (same as with membrane between insulation and concrete)
Conclusions

- Vapour open insulation:
  - Gives higher drying speed
  - Lower moisture level after stability

- Basement should be heated to see some effect

- Internal boards or extra internal insulation should not be added before the wall is sufficiently dry