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Assignment

Moisture performance of ProVent underflooring product

Background and objectives

In Finland the Sisä RYL 2000 /1/ (the Finnish quality demands for building works inside the houses), requires that when parquet or laminate flooring is installed above stone-base floor section (typically concrete slab), there shall be a 0,2 mm thick polyethylene (PE) foil installed between the flooring and the slab in order to protect the flooring against the rising moisture. The joints of this PE layer shall be overlapping and taped.

This requirement has not been presented using material performance properties, like vapour resistance of the layer, but as a performance that is related to a general product. When some other product is to be used as underflooring layer instead of the PE-foil, the performance of this product against moisture flow should be determined first.

This study was done to evaluate the applicability of the ProVent product to be used as underflooring layer.

Use of ProVent product

The ProVent underflooring product is 3,6 mm thick plastic foam product that has an HDPE foil as a vapour resistance layer.

The moisture performance of the product is meant to be enhanced by air movement through the grooves to the sides of the layer by making use of the pressure variations produced by steps on the flooring. This phenomenon was not taken into account in this study.

According to tests done at VTT /2/ the vapour permeability of the ProVent product is about $10{,}9 \cdot 10^{-12}$ kg/(m^2 s Pa) corresponding to vapour resistance factor $\mu = 4960$, or Sd = 18 m, when the resistance is compared to the thickness of a still air layer.

Moisture performance study

The moisture performance of the ProVent underflooring product was studied by using numerical simulation with WUFI 4.1 –programme /3/. Moisture flow rates and moisture fields were compared in cases having similar floor structures except the underflooring layer that was either the ProVent product or 0,2 mm thick PE film.

<u>Structure and materials</u>

Figure 1 represents the floor section that was studied in the simulations. There is 18 mm thick layer representing parquet or laminated floor material. The vapour diffusion properties of this layer were set to correspond to a high density wooden product, which gave some additional safety when compared to typical base material of laminate flooring.

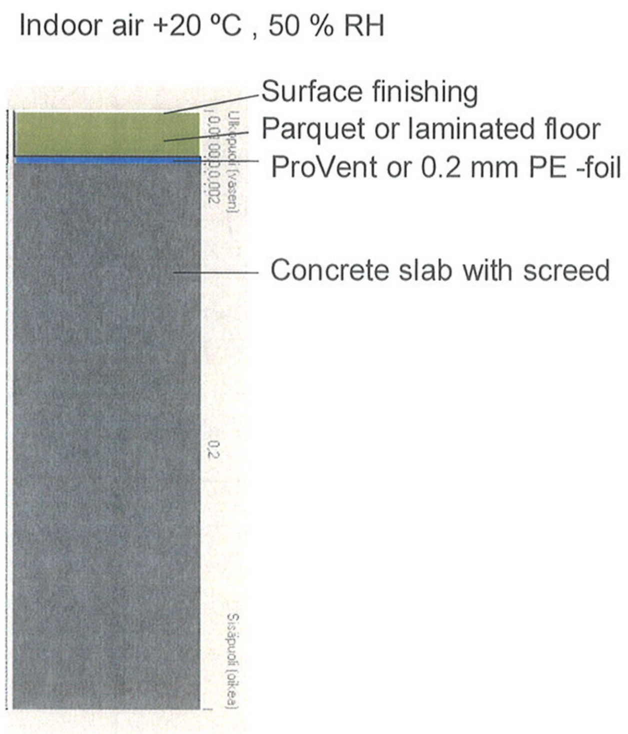

Figure 1. Floor section studied in the simulations.

An additional vapour resistance was set to the upper surface of the flooring to represent the finishing of the parquet or the surface layer of the laminate. Two resistance levels were used for the upper surface layer of the flooring:

$2{,}5 \cdot 10^{+10}$ (m^2 s Pa)/kg (Sd = 5 m) and $5{,}0 \cdot 10^{+10}$ (m^2 s Pa)/kg (Sd = 10 m). These resistances, together with the resistance of the base material of the flooring, represent relatively high resistances for floorings.

In the simulations the vapour resistance of the ProVent product was that determined in the tests /2/ and the vapour resistance of the reference material layer was set to be $2{,}5 \cdot 10^{+11}$ (m^2 s Pa)/kg (Sd = 50 m) corresponding to that of an assembled 0,2 mm PE foil.

Below the underflooring there was 200 mm concrete slab covered with 10 mm layer of screedings.

Initial moisture content of the material layers

The initial moisture content of the 18 mm thick flooring was set to correspond to the equilibrium moisture content under 75 % RH (relative humidity). The other layers had 85 % RH equilibrium moisture content that corresponds to typical upper limit criteria for the installation of flooring.

Climate conditions used in the analysis

The indoor air was assumed to have constant conditions, +20 °C and 50 % RH. Temperature of the concrete slab and the lower surface of the slab were also set to have constant +20 °C temperature. Same temperature level on the slab, flooring and indoor air increases the safety of the studied case (higher moisture flow from the slab) when compared to cases having lower temperature on the slab.

Criteria

The simulation period was three years. During that time most of the additional initial moisture dried out from the concrete slab. The moisture fluxes from concrete slab through the underflooring into the flooring (moisture load) and out from the flooring to indoor air (drying) were studied as well as the humidity conditions between the flooring and the underflooring layer.

Study of the results

The additional initial moisture of the concrete layer tends to dry out from the structure through the protective underflooring layer into the flooring and through it into the indoor air. The moisture fluxes out and into the flooring layer are critical factors when evaluating the moisture performance of the structure. During the three year simulation period time most of the additional initial moisture of the floor structure dried out and the moisture conditions were balanced.

The underflooring should protect the flooring layer against moisture from below. When the drying moisture flux exceeds the incoming flux, the moisture performance is safe. Figure 2 represents the net moisture flux of the 18 mm thick flooring layer in four different cases. The net moisture flux was in every case negative and it approached zero, ie. the flooring was drying from initial moisture level (75 % RH) until it reached steady conditions in about two years. The differences between the net moisture fluxes of flooring caused by the underflooring (0,2 mm PE-foil or ProVent underflooring) were relatively small. When the net moisture fluxes are considered, the moisture performance is about the same in cases with 0,2 mm PE-foil or ProVent underflooring.

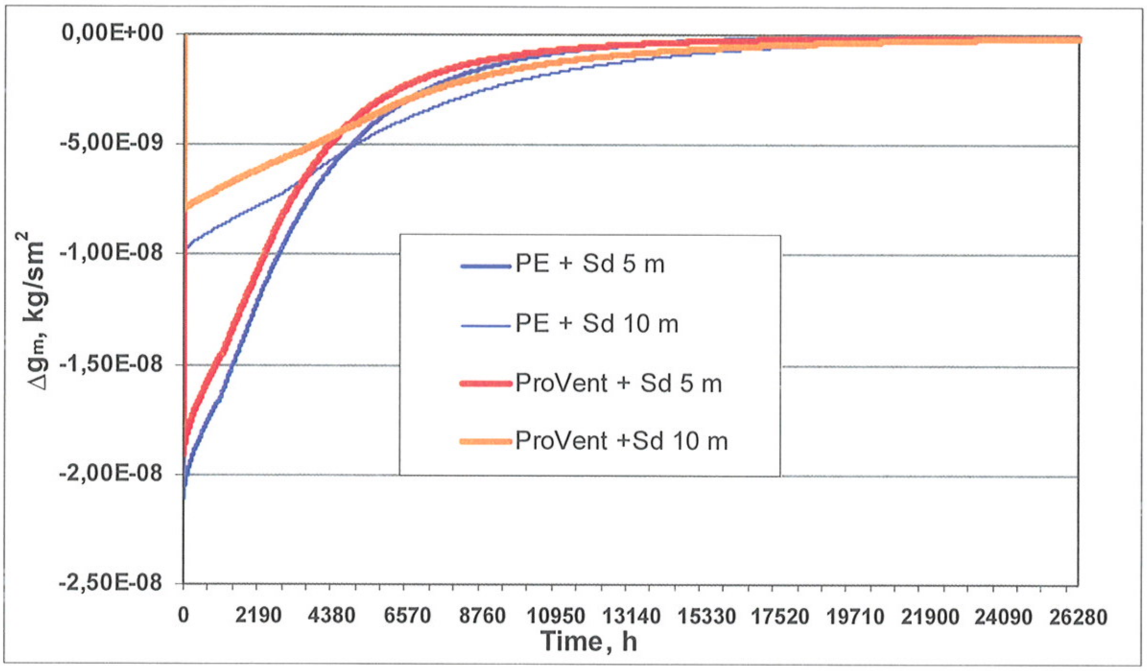

Figure 2. Net moisture flux into the flooring (parquet or laminate). The additional vapour resistance of the surface of the flooring was Sd = 5 m or Sd = 10 m and the underflooring was 0,2 mm PE-foil or ProVent product. Negative flux means that moisture is drying out from the flooring.

Figure 3 presents the relative humidity conditions at the interphase of the flooring and protective underflooring layers during the three year simulation period. In each case the underflooring reduced the incoming moisture flux so that the initial moisture content of the flooring (75 % RH equilibrium) could decrease and reach a steady level in about two years. The final levels depended on the case, but they were significantly lower than the initial level or a critical level that could enable biological growth under long periods.

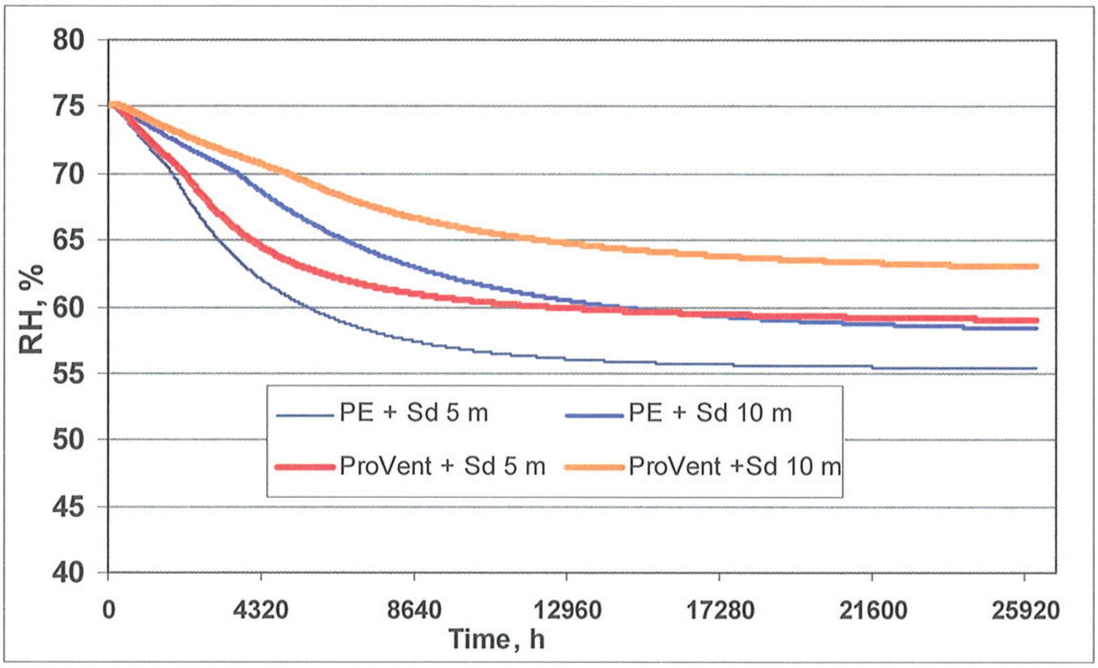

Figure 3. Relative humidity conditions at the interphase of the flooring and protective underflooring layers during three year simulation period. The initial moisture condition of the flooring corresponded to 75 % RH equilibrium and that of the concrete 85 % RH equilibrium. The additional vapour resistance of the surface of the flooring was Sd = 5 m or Sd = 10 m and the underflooring was 0,2 mm PE-foil or ProVent product.

The moisture was almost evenly distribution in the 18 mm thick flooring layer in all the analysed cases. This was due to the vapour resistances on both sides of the layer, the underflooring and the top surface layer (parquet finishing or top laminate of the flooring). Thus the relative humidity of the intersection between the flooring and underflooring (Figure 3) represents also the local maximum relative humidity in the layer with good enough accuracy.

Conclusions

The vapour resistance of the ProVent –underflooring product is adequate to maintain the moisture flux from a concrete slab (having 85 % RH moisture equilibrium conditions) in a safe level when considering the moisture performance of parquet or laminated flooring. The net moisture flux of the parquet or laminate flooring (with 75 % RH initial equilibrium moisture) showed about similar drying conditions both when ProVent product or 0,2 mm PE underflooring were used.

The vapour resistance of the ProVent –underflooring product gives the flooring about same protection against the rising moisture as the 0,2 mm PE foil and it corresponds to the requirements presented for underflooring in Sisä RYL 2000 /1/. The prerequisite is that the installation of the product does not affect the vapour resistance level of the product.

Espoo, 29.8.2008

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References

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2. Research Report VTT –S-00339-07. 2007. 3 s.
3. WUFI (**W**ärme **u**nd **F**euchte **i**nstationär - Transient Heat and Moisture) 4.0 Pro software, The Fraunhofer Institute for Building Physics IBP

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