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Sjöberg, Anders; Nilsson, Lars-Olof

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LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

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Anders Sjöberg
Ph.D. Assistant Professor
Division of Building Materials, Lund University
P.O. Box 118, 221 00 Lund
anders.sjoberg@byggtek.lth.se

Lars-Olof Nilsson
Professor
Division of Building Materials, Lund University
P.O. Box 118, 221 00 Lund
lars-olof.nilsson@byggtek.lth.se

ABSTRACT

This study was performed on 42 floor slabs where the moisture was measured at several occasions and the effect of cast in under floor heating was evaluated. A simulation model of moisture redistribution is present.

Major finding was that the drying time decreases when the floor heating is started early under the drying process and moisture measurement should be made right between the heating pipes at 40% of the depth of the concrete slab.

There seems only to be a small risk of enhanced moisture conditions in the wood flooring if the underfloor heating is turned off during the first year.

Key words: Concrete slab, Moisture, Underfloor heating, Wooden floor

INTRODUCTION

For reasons of comfort, the use of underfloor heating in concrete floors is increasingly common. In newly built single family houses, it is more the rule than the exception for the heating system to be installed as underfloor heating. The main intention is to avoid "cold floors"; even when wood floors are used which are traditionally regarded as pleasantly warm, underfloor heating is often specified.

From the standpoint of moisture, a construction with underfloor heating has several advantages, but there are also a number of points which must receive special attention if moisture damage and moisture problems are to be avoided.

Most of these are relatively well known, but some aspects require research to elucidate the issues more fully, so that specifications may be drawn up for practical and safe treatment of underfloor heating at the design and construction stages. Thermal insulation, thicker than normal for energy conservation reasons, that is installed below the heating pipes provides very good protection against soil moisture in the vapour phase owing to the large temperature gradient across the thermal insulation. If underfloor heating can be used during the construction stage, moisture of construction can also dry out sooner since the concrete slab can be warmed up.

It is found that wood floors normally have a relatively low moisture resistance, compared with the moisture resistance of the concrete subfloor and the moisture resistance of the adhesive used to bond the wood floor to the subfloor. Because of this, the upward moisture transfer from the concrete subfloor passes through the wood floor without causing major wetting of the underside of the wood floor, provided that the subfloor is not too moist and the moisture resistance of the wood floor is not too high.

Matters are more difficult if the room climate is humid. When RH is 60%, it is difficult to prevent RH at the underside of the wood floor exceeding 65%. This needs research so that the manufacturers limiting value of 65% RH may be raised.

Underfloor heating below a wood floor provides very high temperatures in the subfloor so that the surface temperature of the wood floor may be raised. The reason for this is that wood is a relatively good thermal insulator, i.e. it has a relatively large resistance to heat transfer.

The thermal resistance of a wood floor is of the same order as the surface resistance between a surface and the air. This means that the temperature difference between the top and bottom of the wood floor must be of the same order as the desired temperature difference between the wood floor and the air. With a room temperature of +20°C and a desired surface temperature of +27°C, the temperature below the wood floor must therefore be +34°C. A thick wood floor requires even higher temperatures in the concrete subfloor.

Some of the questions that have been raised in conjunction with the bonding of wood floors to concrete subfloors containing construction moisture are

- How dry must it be before the wood floor is bonded on?
- Does the construction function without a polyethylene foil as moisture insulation?
- What happens when the heating is turned off?
- Are conditions different for different wood floors?

2. METHODS

2.1 Materials

Two types of concrete based on ordinary Portland cement were used as a substrate to the floorings. These were normal structural concrete (NSC) with a water cement ratio (w/c-ratio) of 0.6 and a self desiccating concrete (SDC) with w/c-ratio of 0.4. By varying the w/c-ratio different sets of properties of the substrate were obtained according to Sjöberg (1). For instance, a concrete with a low w/c ratio is more alkaline and more impervious to e.g. moisture than the one with high w/c ratio , provided that they are based on the same type of cement.

120 mm thick concrete slabs (1200×800 mm) were cast in moulds of extruded cellular plastic, see figure 1. The walls of the mould were 100 mm thick and its bottom 200 mm. On the inside of the mould a vapour barrier of double plastic sheeting was laid to prevent undesired downward drying of the concrete slab. After application of the flooring the plastic sheets were sealed against the edges of the flooring materials with aluminium tape.

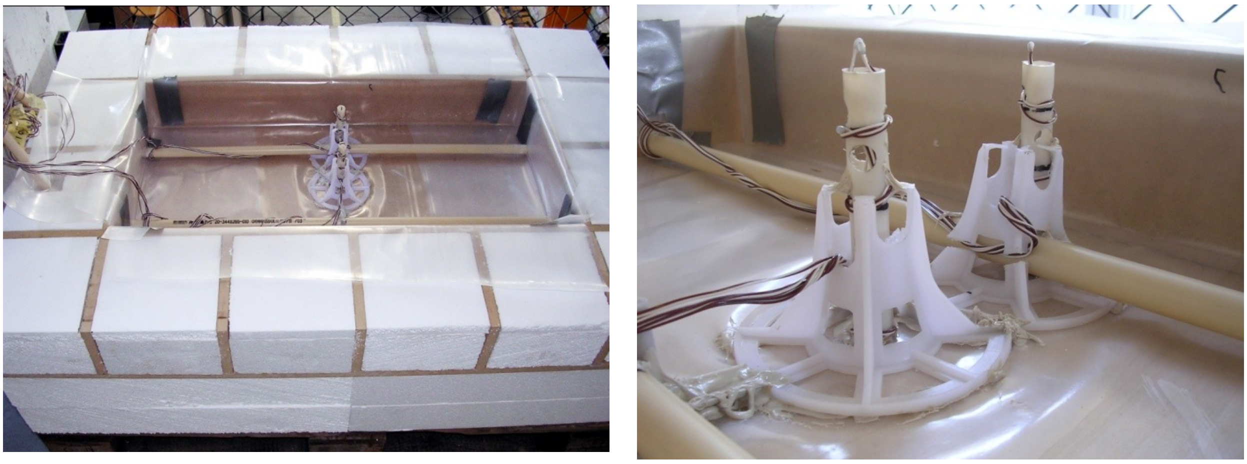

Figure 1. Mould (batch 1) with cast in heating pipes and console for thermo element.

Four different floor covering materials were used in this study, one rubber based flooring (R) and three types of wood based floor coverings (W1-3). Moisture depended material parameters has been determined in this study and are described in section 5.1.

The rubber flooring was attached to the substrate with 0.33 kg/m^2 of an acrylic based adhesive [proff solid 3480]. The open time from applying the adhesive until the flooring was attached was about 13 minutes at 20°C and 60% RH. The wood floor was attached with 1 m^2/litre MS-polymer adhesive with no actual open time.

2.2 Test setup

This study was performed on 42 specimens divided into three batches. All batches included both NSC and SDC. All times and data are summarised in tables 1 & 2.

Directly after casting the concrete surface was covered with a plastic sheet allowing a period of sealed curing. Thereafter the plastic sheets were removed, allowing the concrete to dry from one side only, up through the free surface, for a period of time before the floorings were attached. One week prior to the application of flooring, the concrete surface was screeded with ca 3 mm of a cement based self levelling compound.

The first batch consists of 18 specimens, all with rubber based flooring, conditioned at 20°C and 60% RH. The parameters studied were the influence of w/c-ratio, the depth of the underfloor heating pipes and the drying time prior to flooring. The second batch consists of 12 specimens, all with wood based flooring, conditioned at 20°C and 60% RH. The parameters studied were the influence of w/c-ratio, different types of wood floor coverings, and the drying time prior to flooring. The third batch consists of 12 specimens who were identical to the second batch with the exception that they were conditioned at 20°C and 30% RH.

2.3 Measurements

Temperature and moisture conditions were measured in the specimens on several important occasions. Temperature measurements were performed with cast-in Type T thermocouples.

Moisture measurement was performed on concrete samples removed from several depths in the slab and placed in a sealed test tube according to the regulations specified in RBK (2). A carefully calibrated RH probe was placed in the test tube and the readings were noted after two days when the system had reach its equilibrium, Sjöberg (1). In a pre-study the RH probes were put in holes drilled directly in the concrete slab according to Nilsson (3). This trial method was abandoned as it results in condensation problems on the probes and unreasonably large uncertainties concerning temperature effects.

The first moisture measurement was made at the same time as the application of the flooring, the second measurement during the redistribution of construction water, and the third measurement when the moisture level beneath the flooring had reached its peak value.

3. RESULT OF MEASUREMENTS

3.1 Temperature

The temperature of the cast-in heating pipes was continuously adjusted relative to a maximum temperature of 27°C on top of the flooring, in order to correspond to the maximum temperature gradient allowed in an underfloor heated construction. Measured temperature profiles for four different cases are shown in figure 2. The solid lines represent the temperature profile through the concrete slab near the heating pipe and the dashed lines the profile between these. The labelled cases in figure 2 are based on the type of flooring used and the depth of the cast-in heating pipes. Case 1 represents the mean value of the specimens with rubber based flooring and heating pipes at 30 mm depth, case 2 the specimens with rubber based flooring and heating pipes at 100 mm depth, case 3 the specimens with 14 mm multi layer parquet, and case 4 the specimens with 20 mm solid board. Cases 3 and 4 have the heating pipes cast in at 100 mm depth.

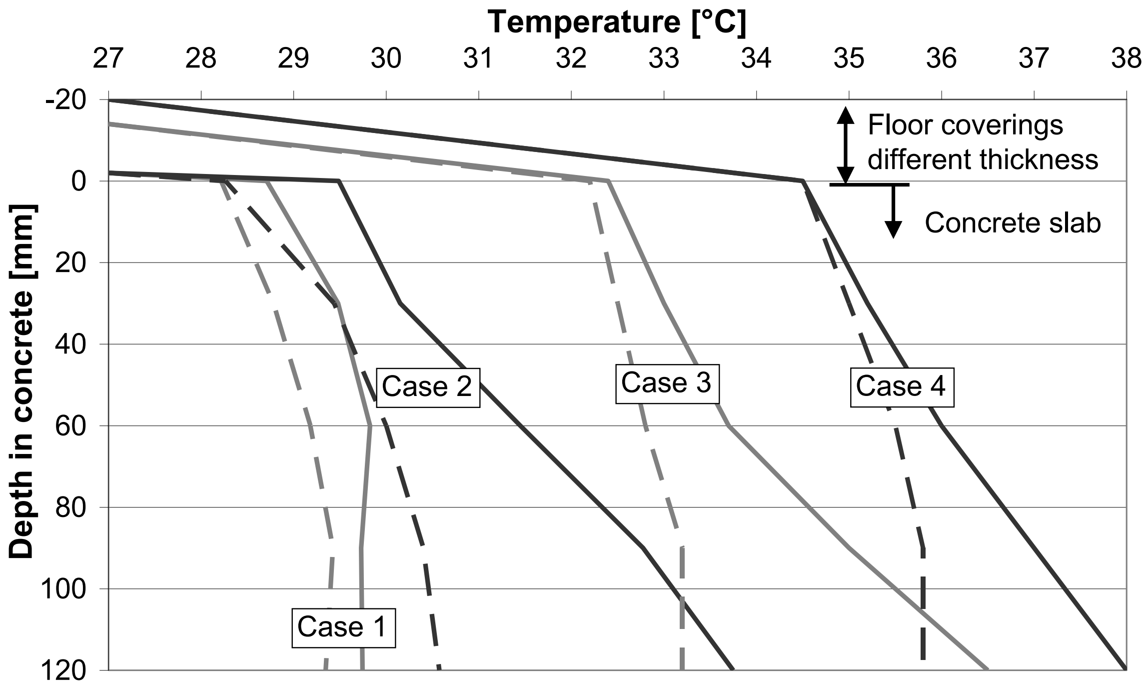

Figure 2. Measured temperature profiles (mean values) through concrete slab and flooring for four cases.

It is clearly shown in figure 2 that the temperature in the concrete rises owing to the greater thermal resistance of the thicker flooring material. Case 1 with heating pipes at 30 mm gives a lower temperature above the pipe (solid lines) than case 2. This difference occurs because the temperature in the heating pipe is adjusted relative to the temperature between the pipes, represented as the top of the dashed lines.

3.2 Relative humidity

Moisture measurements on the samples removed from 5-10 different depths in 42 samples on 3 occasions provide the study with hundreds of moisture profiles. All these moisture profiles are fully shown in Sjöberg & Nilsson (4,5). The mean value of each measured moisture profile is summarised in tables 1, 2 & 3.

Table 1a. Times and data for batch 1.

Specimens	1	2	3	4	5	6	7	8	
Drying climate	60	60	60	60	60	60	60	60	% RH in 20°C
Flooring	R	R	R	R	R	R	R	R	Types of flooring material
Concrete	0.4	0.4	0.4	0.4	0.6	0.6	0.6	0.6	W/C-ratio
Depth-pipe	30	30	100	100	30	30	100	100	Depth, mm from surface
Sealed curing	28	28	28	28	28	28	28	28	Days (time of period)
Drying time	14	28	13	28	14	28	5	28	Days between curing and flooring
Heat start	16	30	15	30	16	30	7	30	Days between curing and heating
Measure 1	1	1	2	1	1	1	2	1	Days from flooring to first measure
RH middle	87.8	87.0	85.4	88.2	92.3	91.8	93.1	94.3	% Relative humidity
RH pipe	88.2	-	-	88.8	92.8	-	93.6	93.3	% Relative humidity
Measure 2	139	124	141	125	139	124	141	125	Day from flooring to second measure
RH middle	84.3	83.7	81.9	83.2	87.2	88.2	86.5	87.0	% Relative humidity
RH pipe	84.3	84.0	81.0	83.0	86.7	88.2	86.2	86.5	% Relative humidity
Measure 3	323	309	321	309	323	309	321	309	Days from flooring to third measure
RH middle	81.2	81.3	77.5	83.0	84.0	86.3	83.0	85.5	% Relative humidity
RH pipe	80.2	82.2	76.2	80.7	82.8	87.0	79.8	84.3	% Relative humidity

Table 1b. Times and data for batch 1.

Specimens	10	11	12	13	14	15	16	17	18	
Drying climate	60	60	60	60	60	60	60	60	60	% RH in 20°C
Flooring	R	R	R	R	R	R	R	R	R	Types of flooring material
Concrete	0.4	0.6	0.6	0.4	0.4	0.6	0.6	0.4	0.6	W/C-ratio
Depth-pipe	-	-	-	30	100	30	100	-	-	Depth, mm from surface
Sealed curing	28	28	28	1	28	1	28	28	28	Days (time of period)
Drying time	28	14	28	113	92	113	92	92	92	Days between curing and flooring
Heat start	-	-	-	0	0	0	0	-	-	Days between curing and heating
Measure 1	2	1	2	-57	-64	-57	-64	-64	-64	Days from flooring to first measure
RH middle	87.8	95.3	92.3	80.5	87.3	83.5	90.0	90.2	94.8	% Relative humidity
RH pipe	87.8	92.8	93.2	80.0	87.2	81.6	91.8	-	-	% Relative humidity
Measure 2	139	141	139	47	1	47	1	1	1	Day from flooring to second measure
RH middle	84.8	89.7	91.2	81.8	82.2	85.8	86.7	85.3	89.7	% Relative humidity
RH pipe	85.3	89.8	91.3	81.3	83.0	83.3	85.3	85.2	90.3	% Relative humidity
Measure 3	349	324	349	249	241	249	241	241	241	Days from flooring to third measure
RH middle	81.2	86.0	85.5	78.3	80.3	82.8	82.3	82.8	87.3	% Relative humidity
RH pipe	81.8	86.0	86.2	77.5	79.5	81.5	81.0	83.2	88.3	% Relative humidity

Table 2. Times and data for batch 2.

Specimens	19	20	21	22	23	24	25	26	27	28	29	30
Drying climate	60	60	60	60	60	60	60	60	60	60	60	60
Flooring	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3
Concrete	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4
Depth-pipe	100	100	100	100	100	100	100	100	100	100	100	100
Sealed curing	1	1	1	1	1	1	1	1	1	1	1	1
Drying time	94	94	94	127	127	127	74	74	74	106	106	106
Heat start	101	101	101	137	137	137	83	83	83	118	118	118
Measure 1	-1	-1	-1	-3	-3	-3	-1	-1	-1	-1	-1	-1
RH middle	87.3	87.7	88.8	86.8	87.3	88.5	83.8	83.2	84.8	80.3	81.8	81.7
RH pipe	87.3	87.7	88.8	86.8	87.3	88.5	83.8	83.2	84.8	80.3	81.8	81.7
Measure 2	31	31	31	23	23	23	50	50	50	31	31	31
RH middle	86.5	87.7	87.2	87.3	87.5	86.5	78.0	77.2	78.3	77.0	77.7	77.5
RH pipe	86.2	87.2	88.3	87.8	88.2	85.2	75.7	77.0	77.8	76.7	77.8	77.8
Measure 3	56	56	56	51	51	51	63	63	63	59	59	59
RH middle	84.8	85.8	82.2	82.8	85.3	86.2	77.5	77.3	77.0	77.7	77.8	78.3
RH pipe	84.0	84.8	82.8	82.5	84.2	81.8	76.3	75.5	76.8	77.3	77.0	76.8

Table 3. Times and data for batch 3.

Specimens	31	32	33	34	35	36	37	38	39	40	41	42
Drying climate	30	30	30	30	30	30	30	30	30	30	30	30
Flooring	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3
Concrete	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4
Depth-pipe	100	100	100	100	100	100	100	100	100	100	100	100
Sealed curing	1	1	1	1	1	1	1	1	1	1	1	1
Drying time	45	45	45	80	80	80	46	46	46	81	81	81
Heat start	52	52	52	87	87	87	53	53	53	87	87	87
Measure 1	-1	-1	-1	0	0	0	-1	-1	-1	-1	-1	-1
RH middle	90.6	88.9	89.7	83.6	83.9	85.6	82.4	82.2	82.1	78.4	76.9	77.2
RH pipe	90.6	88.9	89.7	83.6	83.9	85.6	82.4	82.2	82.1	78.4	76.9	77.2
Measure 2	-	-	-	-	-	-	-	-	-	-	-	-
RH middle	-	-	-	-	-	-	-	-	-	-	-	-
RH pipe	-	-	-	-	-	-	-	-	-	-	-	-
Measure 3	81	81	81	83	83	83	81	81	81	81	81	81
RH middle	83.2	83.5	84.3	80.4	81.6	81.3	73.1	73.6	74.1	73.3	76.6	73.0
RH pipe	80.5	82.2	82.8	78.0	81.4	79.3	71.1	74.3	73.8	72.9	73.2	70.8

4. STATISTIC EVALUATION

A statistical factorial evaluation of the measured values in Tables 1 & 2 is performed according to Box et al (6). This evaluation points out the significant influence of several of the tested variables. Some of the variables had a large influence on the RH-level during the first measurements, which were made when the flooring was laid, and decreased with time. These decreasing factors were the influence of w/c-ratio that gives a mean reduction of 6.0% RH in the moisture profile over the time of measurement when the w/c-ratio is 0.4; the effect of starting the heating early before the flooring is laid (mean reduction of 4.7% RH); and an increase in the length of the period of drying before laying the flooring (mean reduction of 1.3% RH).

There were four significant factors, increasing with time, which have an influence on the RH-level. These increasing factors were the influence of the drying climate that gives a mean reduction of 2.4% RH in the moisture profile over the time of measurement when specimens were kept at 30% RH and 20°C; the depth of heating pipes in the concrete where 30 mm gave a mean reduction of 0.9% RH; the use of a homogeneous wooden floor with a lower resistance to water vapour than a less tight parquet flooring (mean reduction of 0.5% RH); and the location of the measurement: near the heating pipe (mean reduction of 0.5% RH) vs. right between the pipes.

5. NUMERICAL SIMULATION

5.1 Model

Calculations of moisture redistribution have been performed by a computer simulation based on a two dimensional finite difference calculation. The simulation is made for a cross section of the specimens divided into 20*20 elements of optional size. The simulation solves the moisture flow equation (ekv.1) for every time step:

$$g = -\delta \frac{\partial v}{\partial x} - \frac{k_p}{\eta} \cdot \frac{\partial P_w}{\partial x} \qquad \left[kg/(m^2 \cdot s)\right] \qquad \text{Ekv.1}$$

where g is the moisture flow, δ *(m^2/s)* is the diffusion coefficient for water vapour transport, v *(kg/m^3)* is the vapour content, x *(m)* is the size of the element, *kp (kg/m)* is the water permeability, η *(Ns/m^2)* is the dynamic viscosity and P_w *(Pa)* is the pore water pressure.

The change in moisture content for each element is calculated in every time step by:

$$\Delta w = \frac{\Delta g}{\Delta x} \Delta t \qquad \left[kg/(m^2 \cdot s)\right] \qquad \text{Ekv.2}$$

where w *(kg/m^3)* is the moisture content and t *(s)* is the length of the time step.

The moisture flow during the following time step is based on the new calculated moisture content. The vapour content at the beginning of the next time step is for instance calculated as:

$$v = v_{old} + v_{sat}(T) \frac{\Delta w}{\Delta w / \Delta RH} \qquad \left[kg/(m^3)\right] \qquad \text{Ekv.3}$$

where v_{old} (kg/m^3) is the vapour content at the beginning of the previous time step, $v_{sat}(T)$ (kg/m^3) is the vapour content at saturation as a function of temperature T and $\Delta w/\Delta RH$ $(kg/m^3\cdot\%RH)$ is the moisture capacity of the material evaluated as the gradient of a sorption isotherm.

5.1 Evaluated material properties

Moisture depended material parameters

The determination of parameters of concrete is based on the measured moisture profiles and thoroughly described in Sjöberg & Nilsson (7). Moisture depended material parameters used in this simulation are summarised in table 4

Table 4. Moisture depended material properties used at simulations

	RH	%	10	30	50	70	85	90	95	99
Wood	W	kg/m^3	29	42	60	79	103	116	134	152
	δ	m^2/s	2.0 E-07	5.5 E-07	1.1 E-06	2.0 E-06	3.3 E-06	3.9 E-06	5.2 E-06	6.5 E-06
	Kp	kg/m	1.0 E-26	1.0 E-26	1.0 E-26	1.0 E-26	1.0 E-26	1.0 E-26	1.0 E-26	1.0 E-26
Con.	W	kg/m^3	20	27	40	60	83	95	115	140
	δ	m^2/s	3.0 E-07	3.0 E-07	3.0 E-07	3.0 E-07	2.9 E-07	2.9 E-07	2.9 E-07	2.3 E-07
	Kp	kg/m	1.0 E-26	1.0 E-26	1.0 E-19	9.9 E-18	9.6 E-17	1.3 E-15	2.4 E-15	6.2 E-15

Rubber based flooring

The rubber based floor covering (R) used in the experiments is 2 mm thick and provides a moisture tight seal on the surface. The flow resistance to water vapour, $Z = 2.4\cdot10^6$ s/m. In the simulations the rubber based flooring is assumed to be completely moisture tight and to have a thermal conductivity of 0.14 W/(m·K). The thermal conductivity of wood is 0.07 W/(m·K) and that of concrete 1.7 W/(m·K).

Wood floor

The various wood floor coverings provide a semi-tight seal of the surface in the experiments. The vapour tightness of material W1-3 was determined by using the cap method according to McLean et al (8) and CEN/ISO (9). The first wood floor (W1) was made of a 20 mm homogeneous tongued and grooved board of pinewood, $Z = 51\cdot106$ s/m at 20°C and $Z = 90\cdot106$ s/m at 30°. The second wood floor (W2) was a 14 mm multi layer parquet with a top layer of about 3,5 mm oak board, $Z = 44\cdot10^6$ s/m at 20°C and $Z = 80\cdot10^6$ s/m at 30°.The third wood floor (W3) was a 14 mm multi layer parquet with a top layer of about 3,5 mm oak divided into three parallel boards, $Z = 57\cdot10^6$ s/m at 20°C and $Z = 98\cdot10^6$ s/m at 30°.In the simulations moisture depended material parameters according to table 3 was used.

5.2 Results of simulations

The result from simulations is illustrated in figure 3 together with results from all measurements. It is shown in figure 3 that there is almost no difference in the moisture levels near vs. between the heating pipes during the first measurement. The difference increases in the second measurement and is largest in the third measurement. The results from the simulation correspond to the values of the third measurement and the agreement is acceptable. The results from the measurement also show that the moisture level decreases with time as the concrete slab is slowly drying out through the flooring.

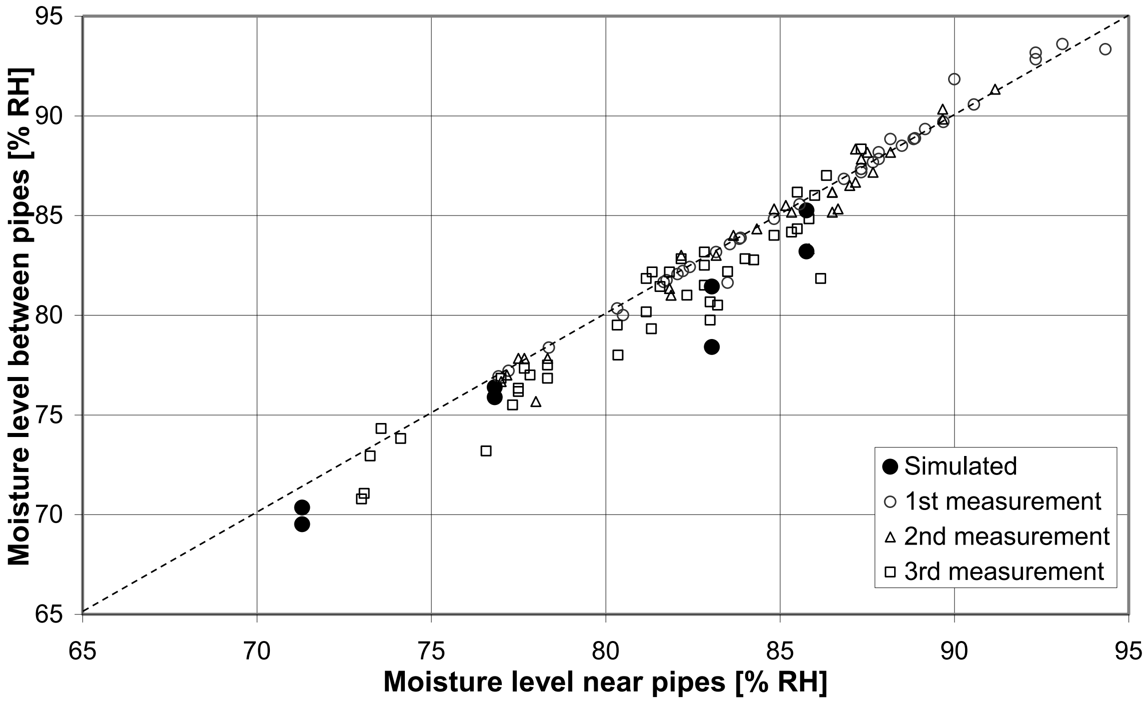

Figure 3. Measured RH-levels near vs. between pipes and simulated RH levels.

The next simulation was performed to sort out how to make a measurement before laying the flooring, in order to ascertain the highest moisture level the floorings and adhesive will be exposed to after redistribution of the remaining construction water. It was assumed in the simulation that all remaining construction water in the concrete at the time the flooring is laid will be trapped and have no opportunity to dry out. The moisture in the middle of the concrete will then be redistributed and will remoisten the dryer top part. It was found in this simulation of 6 different cases that the moisture condition between the heating pipes at 40% depth of the concrete slab was similar to the highest moisture value that later occurred at any time in contact with the flooring. See figure 4. Of the six simulated cases, three had the heating pipes at 30 mm depth and three at 100 mm. For each of these the flooring was simulated after 3, 6 and 12 months of drying period. The underfloor heating was turned on at the same time as the flooring was laid. For every case a "measured" value is shown for the time of flooring and 3, 6 and 12 month thereafter to illustrate the variation with time at the point of measurement. The drying time has by far the greatest influence on the moisture condition, according to figure 4. Whether the heating pipe is cast in at 30 or 100 mm makes no significant difference whatever. Nor does the moisture condition at the point of measurement at 40% depth of the concrete slab fluctuate during the period when moisture is redistributed n the rest of the slab.

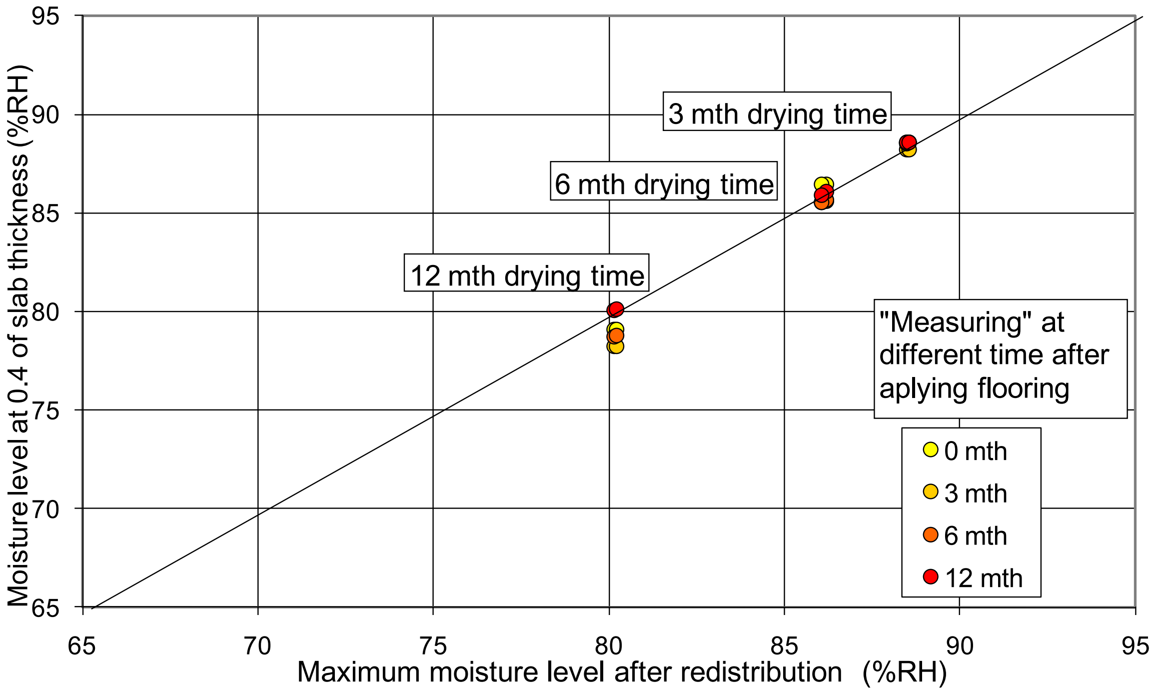

Figure 4. Simulated RH-level at 0.4 depth before flooring vs maximum RH-levels after redistribution.

The third simulation demonstrates the drying process in the concrete floor when a wooden floor is attached after an initial drying. In figure 5 the line labelled “start” shows the moisture distribution in the uncovered concrete slab after two weeks' drying at 60% RH and 20°C. The initial distribution is calculated and shows very good agreement with the measured values.

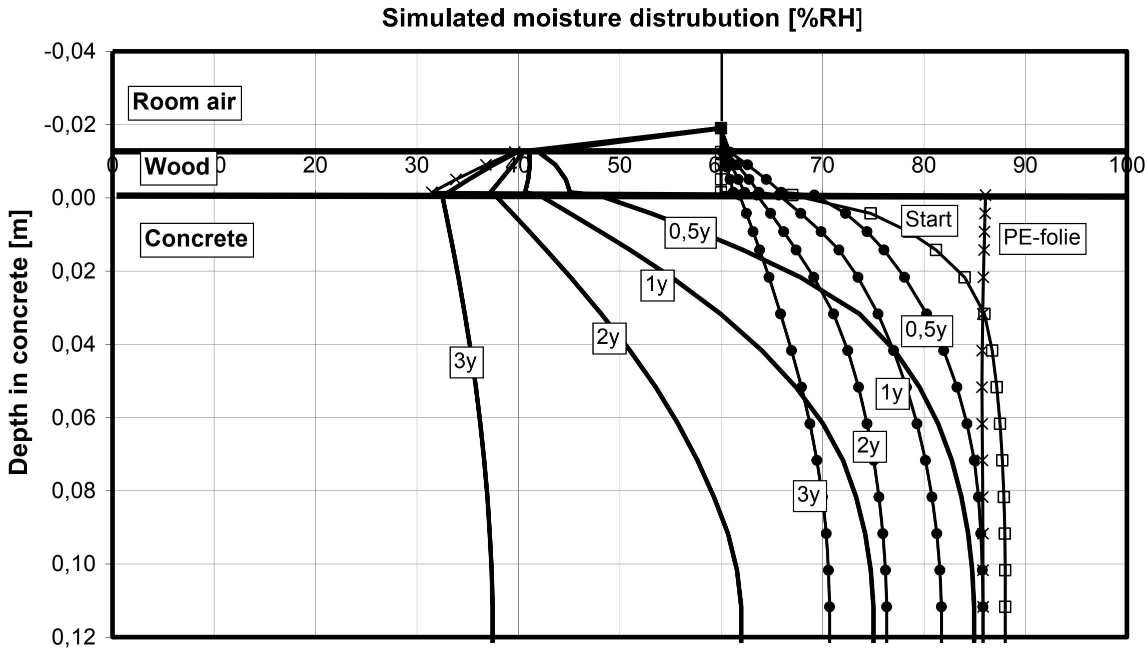

Figure 5. Simulated moisture distribution during three year of drying for three cases. Heating pipes at 100 mm temperature profile according to case 3 in figure 2.

The lines with dots in figure 5 represent the moisture distribution profiles when the slab has an attached wooden floor but no heating. The distribution decreases with time 0.5, 1, 2 and 3 years after the wooden floor is applied. The equilibrium moisture level which the distribution profile will reach after a long time is 60% RH.

The solid lines represent the moisture distribution profiles that occur when the concrete slab has an attached wooden flooring and heating pipes at 100 mm depth. The temperature in the heating pipes is adjusted to produce 27°C at the floor surface. Because of the increased temperature, the relative humidity at the floor surface will almost immediately decrease to approx. 40% RH. There will be a decreasing moisture distribution profile through the wooden flooring and the moisture level of the distribution profile in the concrete will reach an equilibrium at approx. 30% RH after a long time.

The line marked with “x” shows the distribution profile when a moisture barrier, eg a polyethylene (PE) foil, is placed between the concrete slab and the wooden floor. In that case the moisture level in the wood floor will almost immediately reach the same distribution profile as it only does after a long time without the PE foil. The equilibrium moisture level in the concrete will be ca 85% RH. This is the same level as that of the initial profile at 25% of the depth. In Nilsson (7) this equilibrium depth is shown to be 40% when a concrete slab with single sided drying is covered with a tight seal, e.g. a PVC or rubber based flooring. The depth in Nilsson (7) is considered to be on the safe side compared to this study.

In figure 6 the redistribution of the moisture distribution profile is shown when the underfloor heating is turned off 6 months after the wooden flooring was attached. After just a couple of days the moisture level in the surface of the wooden floor has increased from just over 40% RH to nearly 60% RH. After a week the moisture level at the top of the concrete starts to rise. 3-6 months later the system is at its new equilibrium with a significantly higher moisture level in the wood floor at the top of the concrete. The moisture level in the bottom part of the concrete slab is lower than before since it has had time to dry upwards through the whole process.

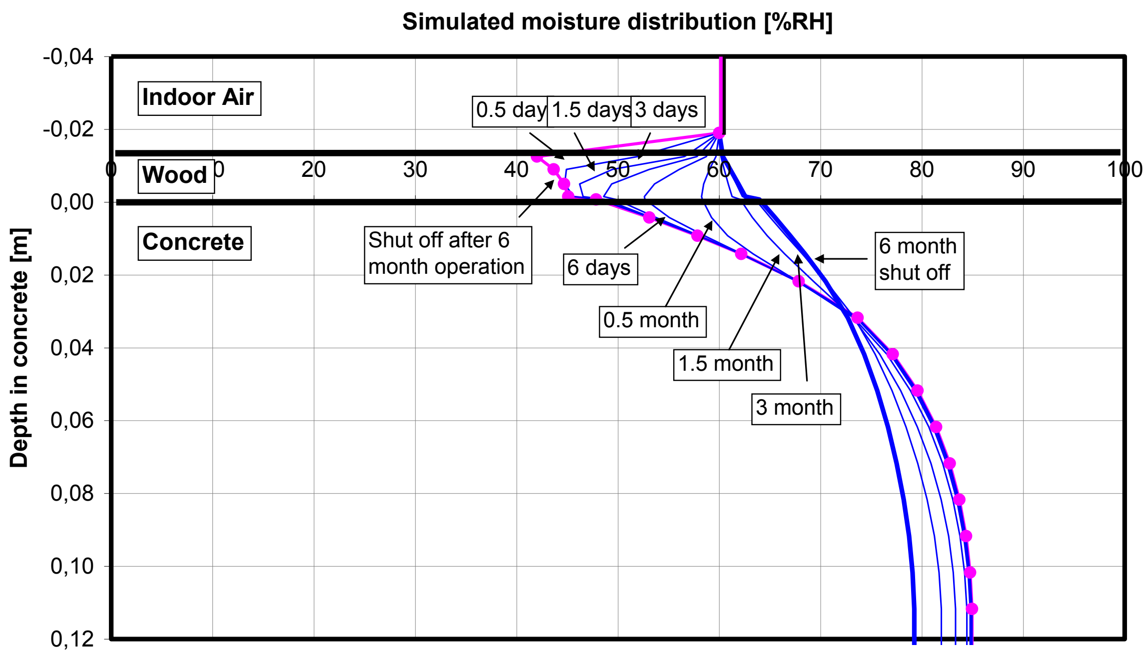

Figure 6. Simulated moisture distribution during six month shut off. Heating pipes at 100 mm temperature profile according to case 3 in figure 2.

6. SUMMARY AND CONCLUSIONS

This study concludes that there is an advantage in making use of the cast-in underfloor heating during the construction phase to speed up the drying of the concrete slab. The influence of starting the underfloor heating early, in practice as soon as possible after the building envelope is closed, was almost 5% RH in this study. At the construction site this may represent a reduction of the drying period by several weeks, maybe months. This is especially the case if the aim is to reach such moisture levels in the concrete substrate that vapour tight PVC or rubber based floorings may be attached without the risk of degradation.

There is only a small difference in relative humidity (RH) level near *vs.* between the heating pipes. In this study the mean difference increased a little, from almost nothing at the time the flooring was laid to near 1% RH after one year. This may indicate that the diffusion of water vapour from hot to cold areas is of the same magnitude as the capillary suction of pore water back to the hot areas.

When floorings are attached on top of the concrete slab the drying process is disturbed. Tight floorings such as PVC or rubber based materials will practically terminate the drying process and initiate redistribution of the remaining construction water. Less tight floorings such as wood will allow a limited drying. The magnitude of the drying through the flooring is dependent on material parameters such as the flow resistance of the materials and conditions such as ambient RH and the temperature profile through the construction.

There seems to be a small risk of enhanced moisture conditions in the wood flooring if the underfloor heating is turned off during the first year. But, on the other hand, this condition will only be the same as if there had been no heating in the first place. No additional water will accumulate in the wooden flooring due to the heat being turned off. A moisture barrier under the wooden floor may not prevent moisture damages, it is most likely it instead will contribute to drying and shrinkage damages in the wood.

A polyethylene (PE) foil placed between the concrete slab and the wooden floor increases the moisture level in the concrete surface and reduces it in the wooden floor. The PE foil may reduce the risk of wetting underneath the wooden floor but may also cause a new risk if the moisture level in the concrete surface exceeds the critical value for e.g. mould growth in the remaining sawdust. The positive effect of the PE foil may be finite since there will only be a minor increase for a short period of time in the moisture level of the wood.

Any measurement before the flooring is laid, in order to ascertain the highest moisture level the floorings and adhesive will be exposed to after redistribution, should be made right between the heating pipes at 40% of the depth of the concrete slab if the slab can only dry out upwards. If the concrete slab can dry out both upwards and downwards, the measurement may be performed at 20% depth.

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