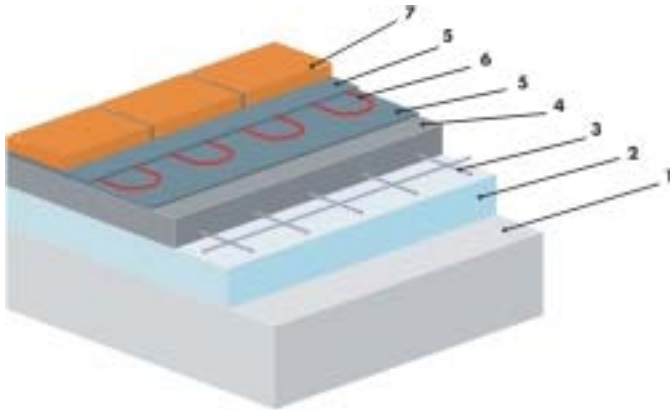


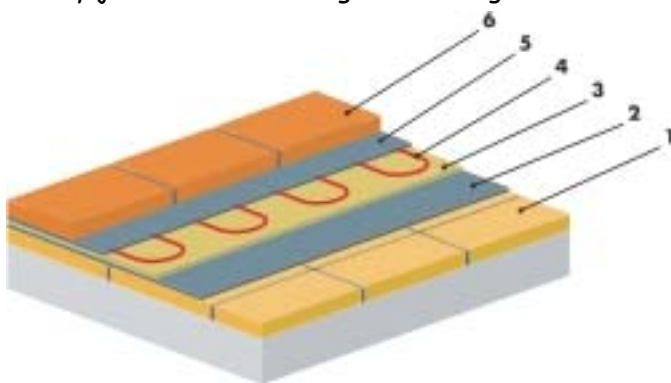
## Measuring the Speed of Floor Warming

Devimat™ heating systems can be used as a primary means of heating or as supplemental heating to the floor tiles for greater comfort - most often in the bathroom. In the latter case, where another heat source (e.g. a hot-water heating device) is used to heat a room and the electric heating mat serves to make a warmer, more comfortable floor, the time for warming the floor tiles is an important variable. Because the system operates for relatively short time intervals (approximately 1-2 hours in the morning and evening), it should be able to warm the floor tiles in the shortest possible time. Heat accumulation and slow cooling of the floor is neither useful nor desirable. The warming speed can of course be influenced by the type of system, and for supplementary heating only a direct (non-accumulating) system should be used.



- 7) New ceramic floor tiles
- 6) Devimat™ heating mat
- 5) Flexible sealing cement (adhesive material)
- 4) Concrete slab
- 3) Reinforcing steel grid - "Kari" grid
- 2) Thermal insulation (extruded polystyrene)
- 1) Load-bearing construction

Even if you use a direct supplemental heating system, however, that is no guarantee that the floor will warm fast enough. The behavior of the floor depends upon its overall composition and, if the structure does not contain thermal insulation, it may take several hours to warm the floor. This problem is particularly significant in cases of reconstruction, because no thermal insulation was usually used in older buildings. That is to say, it is difficult and very expensive to install an additional 6 cm layer of polystyrene because this would mean either to destroy some 10 cm of the floor in order to create space for insulation and the new flooring or to increase the height of the floor by 10 cm. This is often technically impossible. Nevertheless, there exists a solution that is technically and financially practical, and that is to install "F-Board" insulation directly under the Devimat™ heating element. The insulation increases the thermal resistance beneath the heating mat and floor and ensures that the heat is directed primarily into the floor tiles, rather than into the foundation structure. The insulation comes in 6 mm and 10 mm thicknesses. Using F-Boards 6 mm thick, the thickness of the entire new structure is usually just 2.5 cm including the heating mat and new floor tiles.



- 5) New ceramic floor tiles
- 4) Flexible sealing cement (adhesive material)
- 3) Devimat™ heating mat
- 2) F-Board insulation
- 1) Original (existing) floor tiles

The significance of this insulation is demonstrated by over three actual applications where the times to warm the surface of the floor tiles was measured. In all three cases, a heating mat with an output of 150 W/m<sup>2</sup> was installed directly into the adhesive sealing cement beneath the floor tiles.

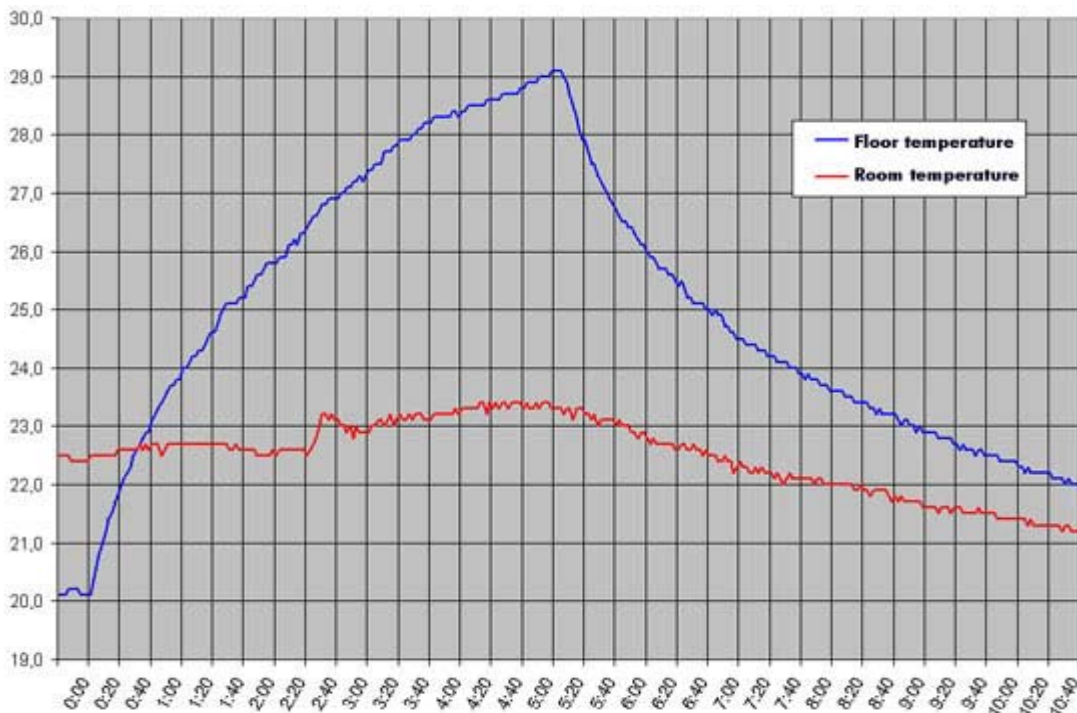
## Bathroom in an apartment building



The apartment with bathroom is situated on the second floor of an apartment building. Built in 1908, the building is of solid construction made from fully baked bricks, with the external walls 80 cm thick. The ceiling and floor structures are of similarly solid construction. The girder ceiling is covered with wooden foundation boards that are themselves covered with a brick floor 4 cm thick, and there is an additional concrete layer 4 cm thick in the bathroom. The building has very good thermal accumulation characteristics and an ideal humidity microclimate.

The apartment is heated using a hot-water system. In the bathroom, a heating mat is installed under the floor tiles into the adhesive sealing cement. There is no additional insulation between the heating mat and the floor construction. Beneath the bathroom, there is another tenant's apartment that is also heated.

As can be seen from the graph above, the time to heat the floor from 20° C to 28° C was 3.5 hours, and to 29° C, 5 hours. After 5 hours of operation, the heating mat was turned off and the floor began to cool down very slowly.



The system definitely works as an accumulating system (caused by the 8 cm thickness of the structure (4 cm concrete, 4 cm brick foundation) beneath the heating mat). In view of the fact that it was supposed to provide only supplemental heating for increased comfort, the entire system can be regarded as essentially nonfunctional. This problem could easily have been prevented by installing additional insulation, as the following cases will indicate.

## Bathroom in a family house

A client reconstructing the bathroom in his family house requested that the electrical heating mat be installed under the floor tiles. In this case, it would serve again as a supplemental heating source for increased comfort, as the bathroom is heated using a hot-water radiator.



The bathroom is situated on the ground floor, and below it is a cold cellar that is not heated. The building is old and there is no thermal insulation in the floor. The floor consists of a concrete slab 8 cm thick (2 x 4 cm) with hydro-insulation.

The prepared floor was covered with CLIMAPOR-POLYPLAN thermal insulation 2 mm thick, a heating mat and new floor tiles.

As can be seen from the graph below, the system works very well and the floor reached the desired temperature in just 26 minutes.



This is despite the fact that there was no thermal insulation in the floor, but there was a POLYPLAN layer 2 mm thick and an unheated room with an average temperature of 5° C - 8° C was directly below the bathroom. The temperature fluctuation in the upper part of the graph (28° C - 29° C) is caused by the thermostat, which switched the heating mat on and off when the required temperatures were reached. Also, the floor cools down much more quickly because the CLIMAPOR-POLYPLAN insulation avoided the unwanted accumulation of heat into the concrete floor.

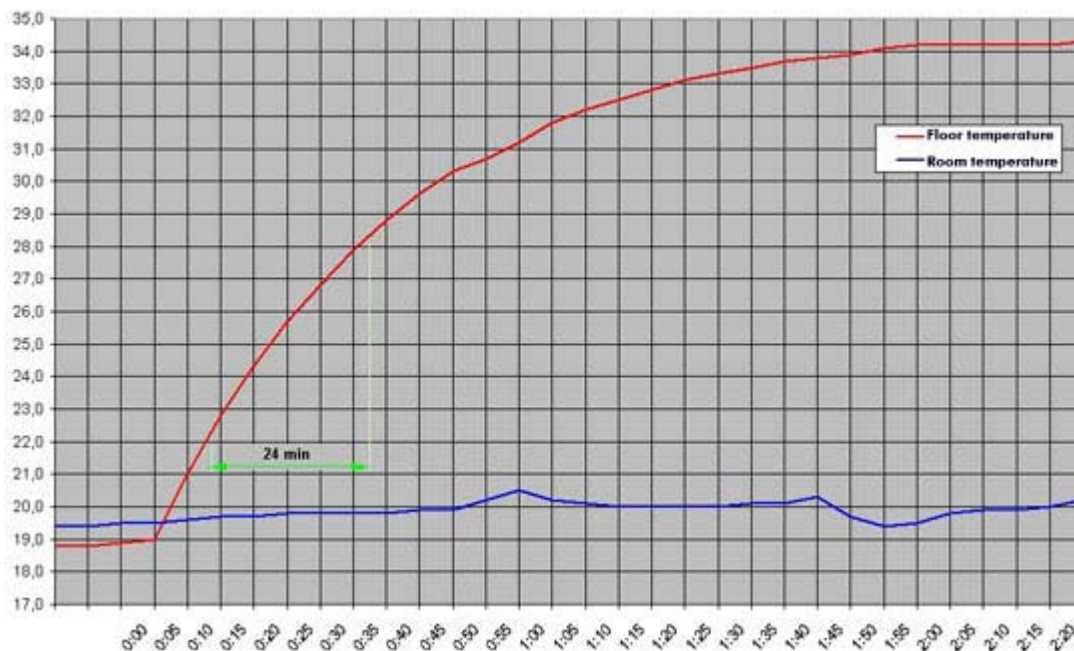
*Continues*

## Test sample with F-Board insulation

In April 2007, a new floor insulation material under the name F-Board was introduced. It was tested for, among other things, the time needed to warm the floor. The original floor of the test room consisted of tiles laid onto the concrete foundation that was directly on bare earth - no thermal insulation beneath. For the test area, a new floor was created on top of the existing tiles and which corresponded exactly with that of the original floor but incorporating F-Board 6mm and a heating mat with output of 150 W/m<sup>2</sup> under the new floor tiles.



Please note in the following graph that the temperature in the test room was only ~20° C, as compared to the bathroom temperatures in the two cases described above.

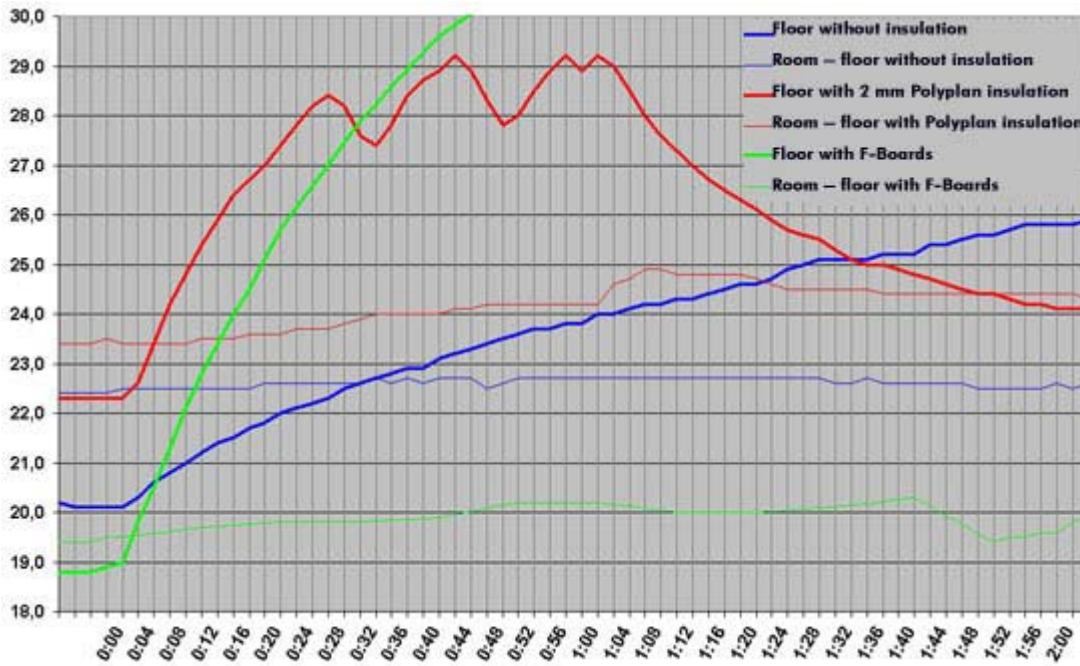


Comparing the warming time curve for the test room with the respective curve for the bathroom in the family house where the CLIMAPOR-POLYPLAN insulation was installed, the time to warm the floor from 22°C to 28°C was 24 minutes, which is "only" 2 minutes less. However, this was reached at a significantly lower room temperature, which is an important factor affecting the time to both cool down and, therefore, to warm up. The greater thickness of F-Board insulation will allow the system to be more dynamic.

F-Boards have other advantages over CLIMAPOR-POLYPLAN insulation. As they are produced in the form of boards, they can be laid very easily. CLIMAPOR-POLYPLAN comes in rolls which show so-called "shape memory effect" when being laid. This means that POLYPLAN tends to "bridge up" on the floor. Each F-Board is covered with sealing cement and hardened glass fabric on both sides. This guarantees excellent adhesiveness of the individual layers as well as the floor's greater mechanical carrying capacity. Provided that the recommended sealing cements are used and the correct laying procedure is followed, F-Board also serves as hydro-insulation, which is very useful for reconstructions or wooden floors.

## Conclusion

To make the comparison simpler, all three applications described above were combined into a single graph comparing the heating performance of the floor over a span of two hours. Each application is shown with a different color (floor temperature curves are in bold while room temperature curves are not).



From this data, we can conclusively say that it is beneficial to use F-Board6 insulation for Undertile heating systems that operate on a periodic heating programme to heat floor tiles and that the initial investment in the F-Board6 will be significantly repaid in the form of flexible and economical operation.