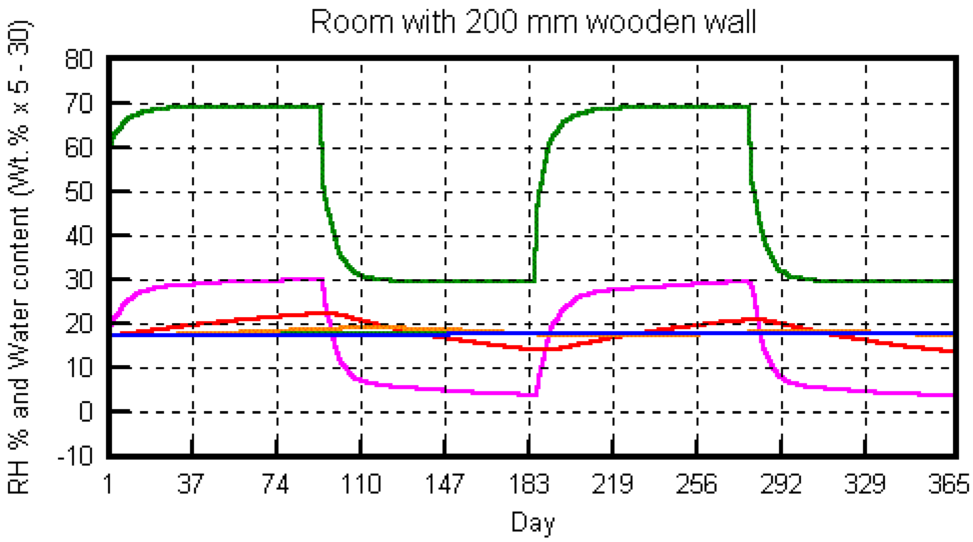
Humidity buffering by museum walls, part 2

Did you miss Part 1?

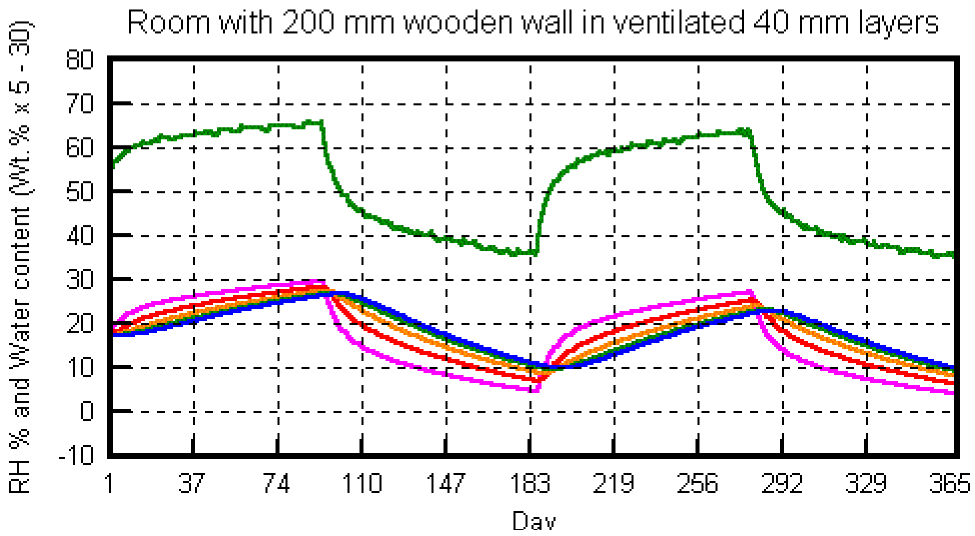
How the wall influences the room climate

The graphs shown in the previous section describe the reaction of the wall to the room climate but do not describe how the wall influences the room climate. I turned therefore to the Padfield/Jensen model. This is more limited in that it will only handle a homogeneous wall and is only tested for accuracy in predicting the behaviour of wood. It does, however, give similar results to MATCH when the two programs are tuned close to unison in their parameters. The two next graphs show modelled results for the climate in a room with 1000 cubic metres volume and 1000 square meters of wooden wall, floor and ceiling: a large scout hut for example. The air change is once per hour.



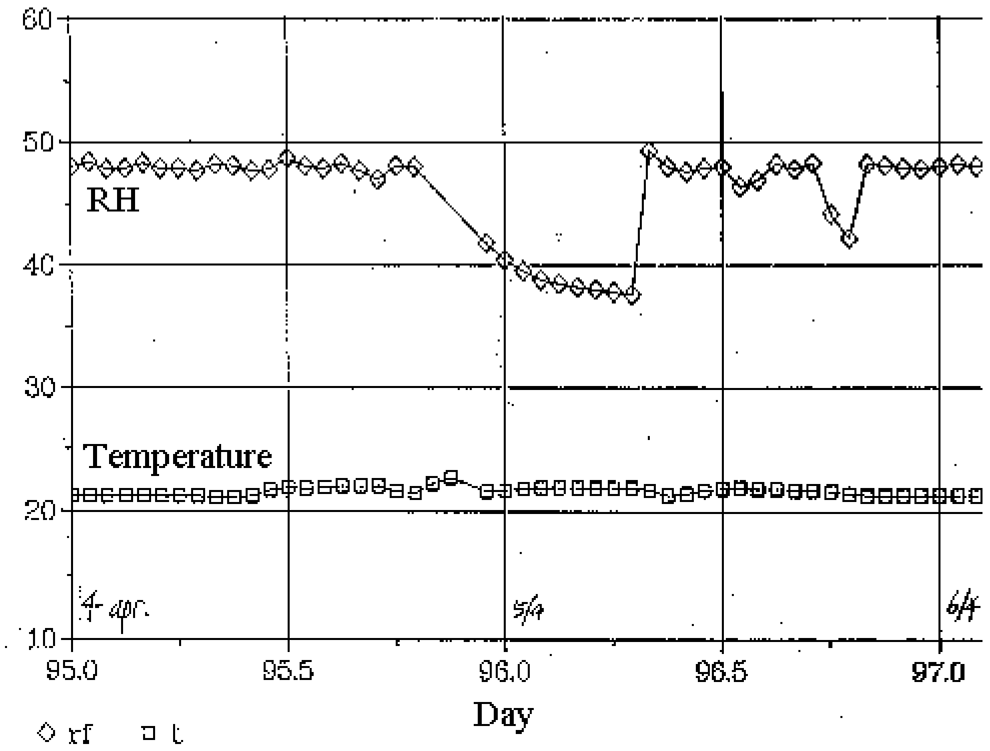
The first graph confirms the prediction in the previous section. Massive wood simply doesn't have the porosity to absorb or release water fast enough to ameliorate the climate. Note that in this graph the upper line is the relative humidity of the room air, while the bunch of lines below is the water content at various depths in the wood, drawn with a peculiar scale, for visual clarity. The water content lines show that the deeper wood (blue line) does not exchange water and is therefore not active in the buffering process.

This disappointing performance can, however, be vastly improved if the wall (and the floor and ceiling) are cut into 40mm thick slices and then re-assembled with air circulation around each slice.



Now there is a good balance between water capacity and the rate of release of water through the surface. The wall has a very marked stabilising effect, giving the interior climate a half time to equilibrium of about two weeks.

This is a very useful degree of stability, as I will demonstrate by presenting a final diagram from real life.



This graph shows the course of the climate in a gallery of the National Museum during a power failure in Copenhagen. The room has a varnished floor and plastic paint on all other surfaces. Most of the exhibits are in glass cases. There is very little absorbent surface to buffer the RH. Notice, however, the stability of the temperature. This is due to the mass of the building. This enviable temperature stability contributes to the instability of the RH. The outside air which filters in around the windows is warmed up and therefore falls in RH. Calculating from the water content of the outside air at that time, the inside RH was heading towards about 30%.

Notice that the RH decline in this last graph stretches over about half a day, while the similar looking decline in the graph for the wooden hut stretches over about 90 days. This stabilisation is achieved by a rather unrealistic slicing of the wood but the practicality of substantial buffering in real buildings is clearly established by this theoretical exercise.

These exercises in digital architecture are hardly likely to overturn modern trends in building technology. Engineers tell us how important it is to install vapour barriers in outside walls and plastic paint is ubiquitous. Only churches are allowed to have porous walls nowadays. That is the subject for a later chapter.

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