Humidity Control in Historic Buildings through Adaptive Ventilation - A Case Study.

Tor Broström,
Carl-Eric Hagentoft,
Magnus Wessberg

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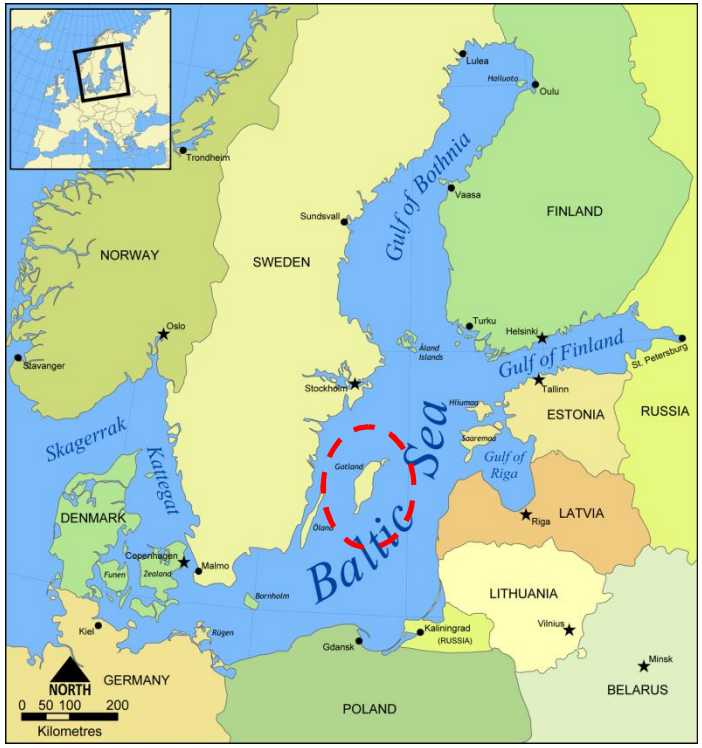
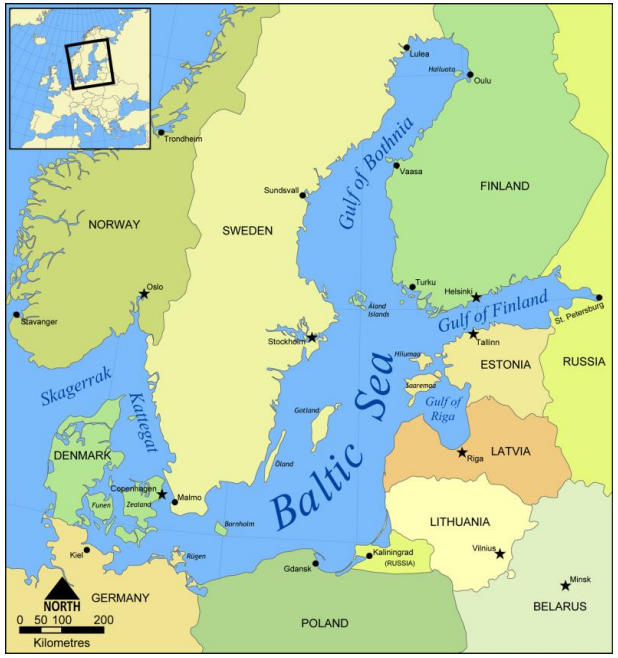
The building



The building



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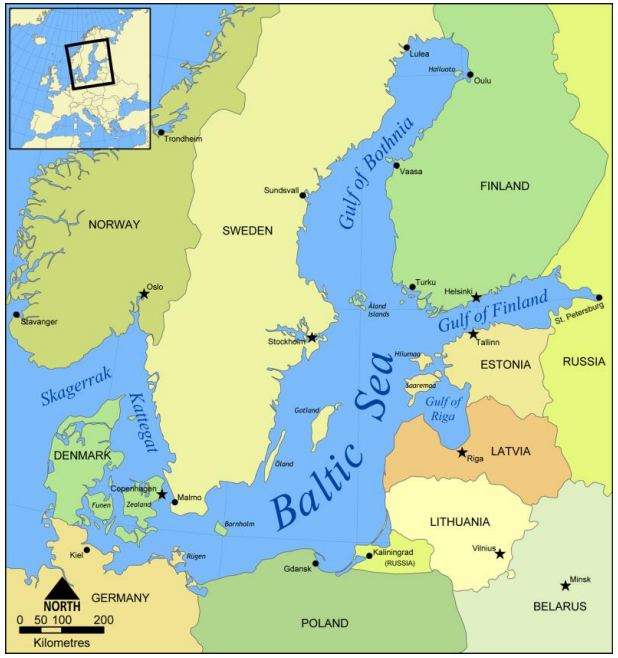

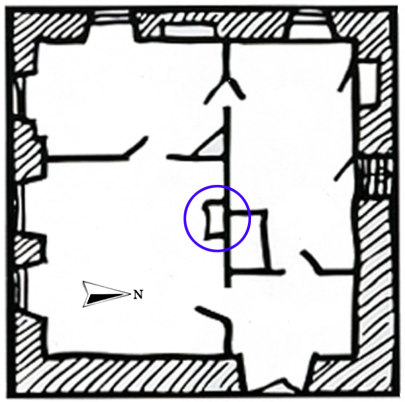

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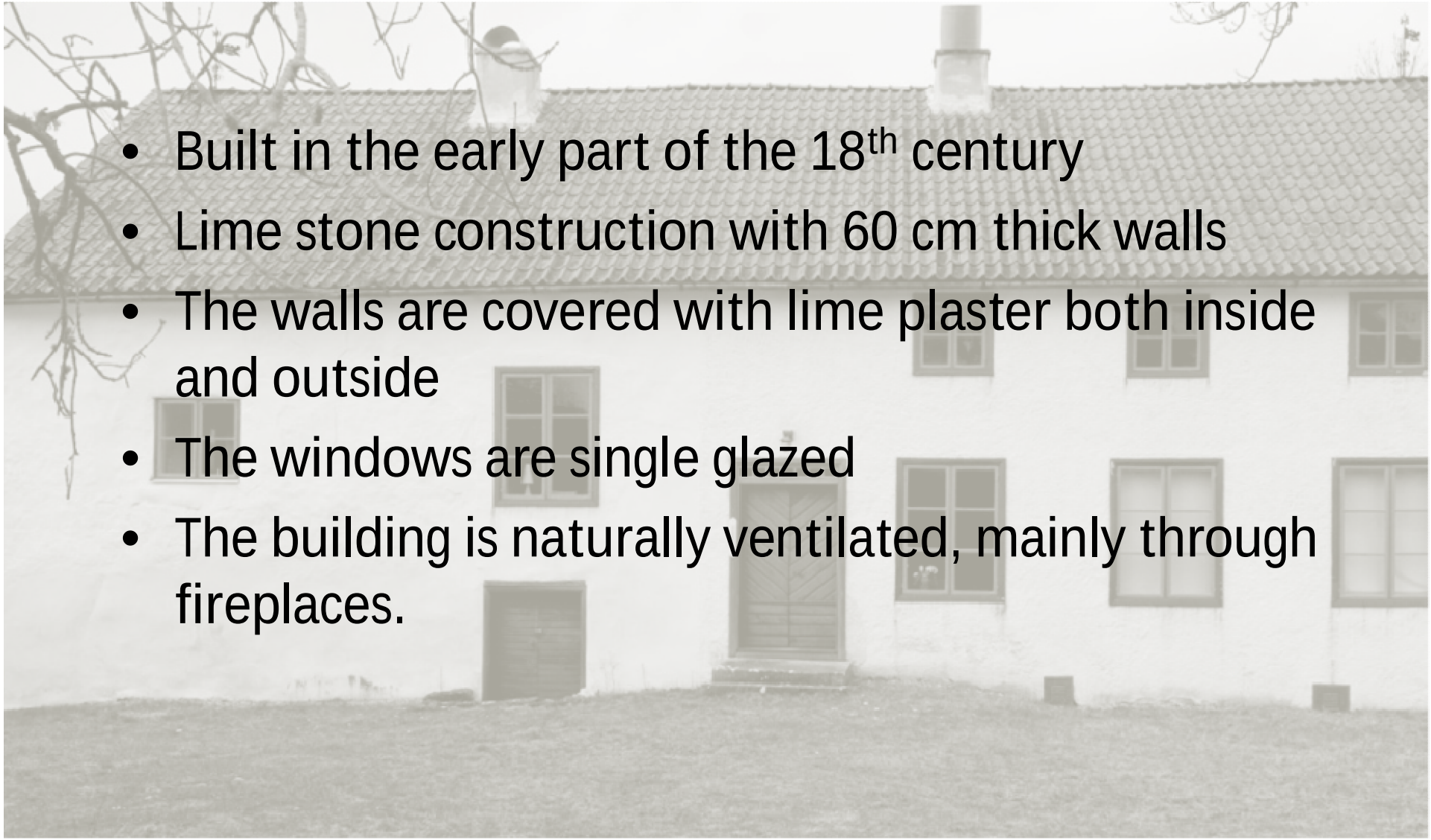
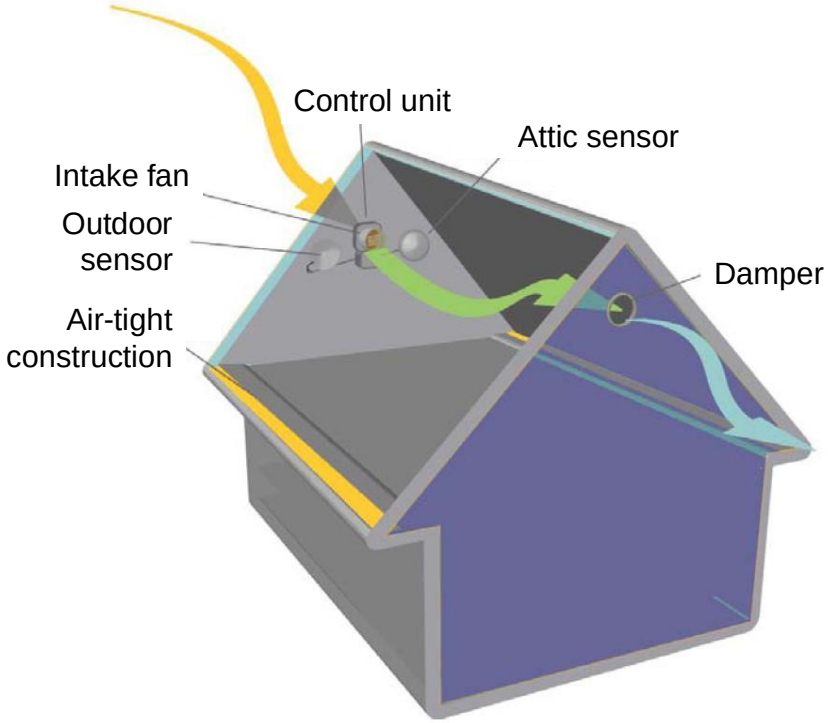


- Built in the early part of the 18th century
- Lime stone construction with 60 cm thick walls
- The walls are covered with lime plaster both inside and outside
- The windows are single glazed
- The building is naturally ventilated, mainly through fireplaces.

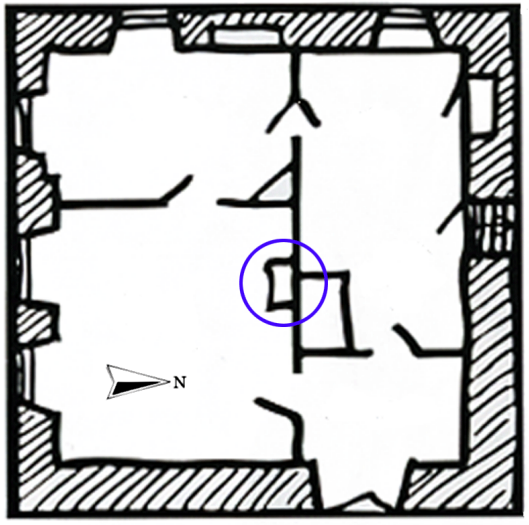
Moisture problems

Adaptive ventilation

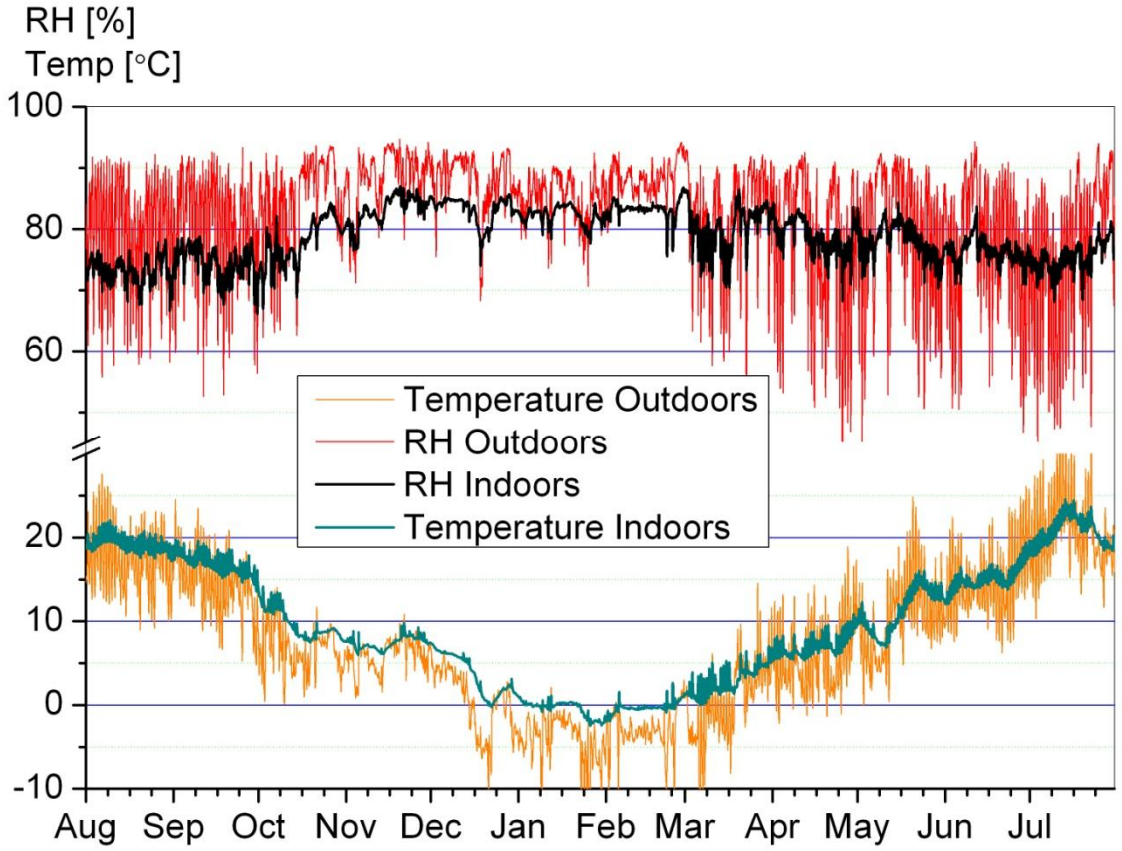
- Ventilate only when the water vapor pressure inside the building is higher than outside.
- Both air tightness and ventilation must be controlled and adopted through the use of mechanical fans and dampers controlled by indoor and outdoor climate sensors.



Adaptive ventilation



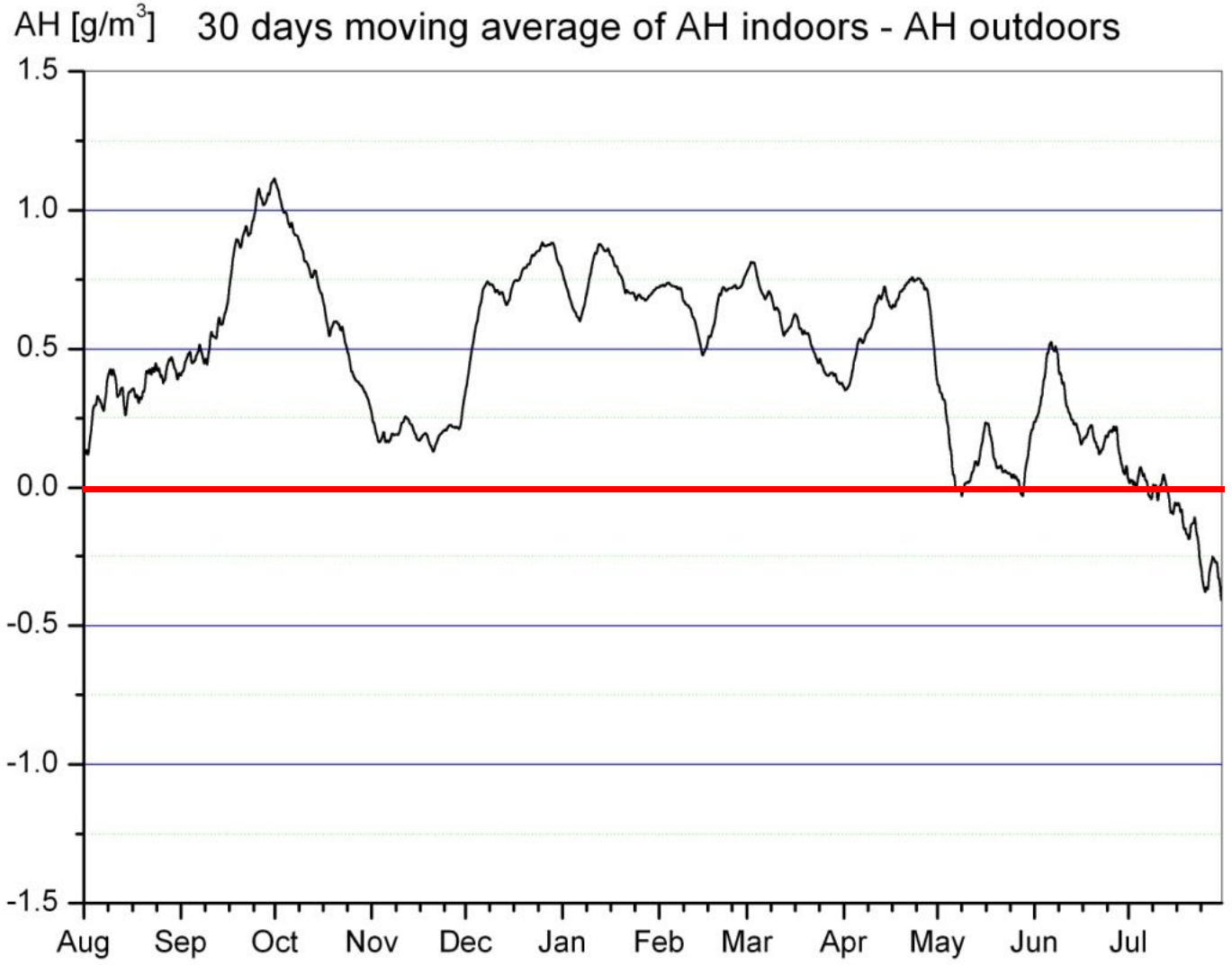
Results



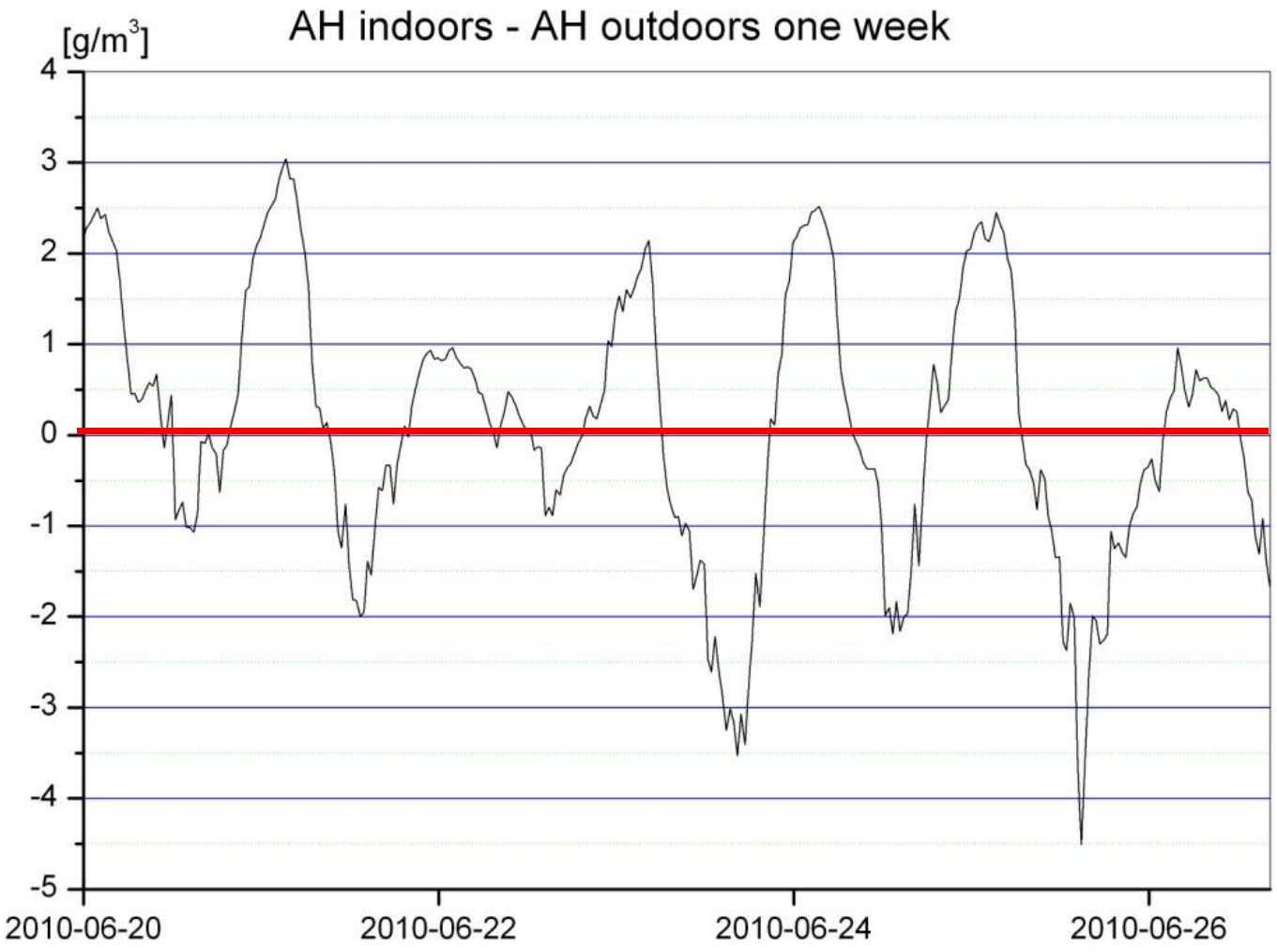
	Average
RH indoors (%)	78.5
RH outdoors(%)	82.1
T indoors (°C)	11.1
T outdoors (°C)	9.3
AH indoors (g/m^3)	8.5
AH outdoors (g/m^3)	8.1

Temperature and RH in the outdoor air and in the ventilated space , August 2009 – July 2010

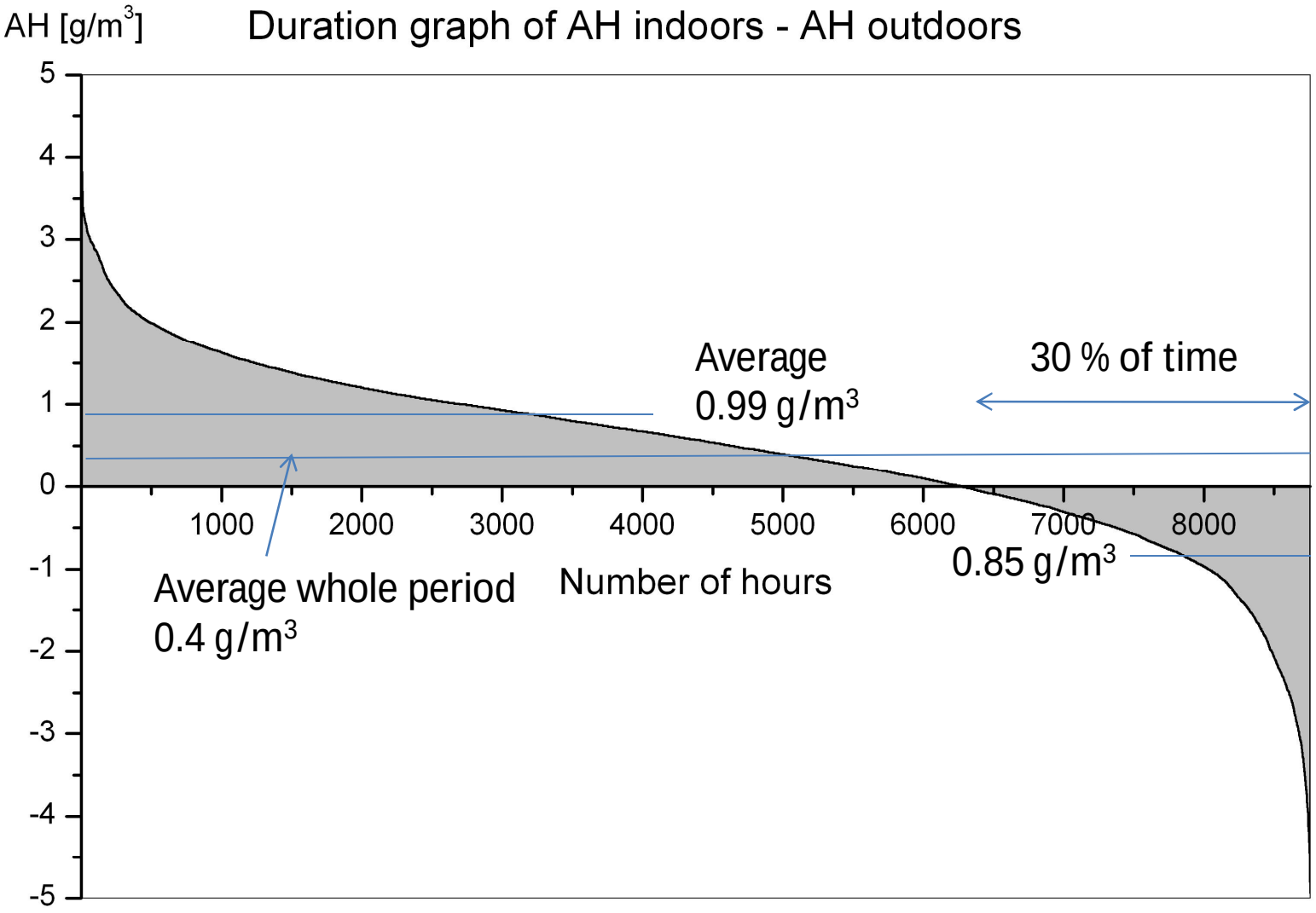
With adaptive ventilation (2009-2010)



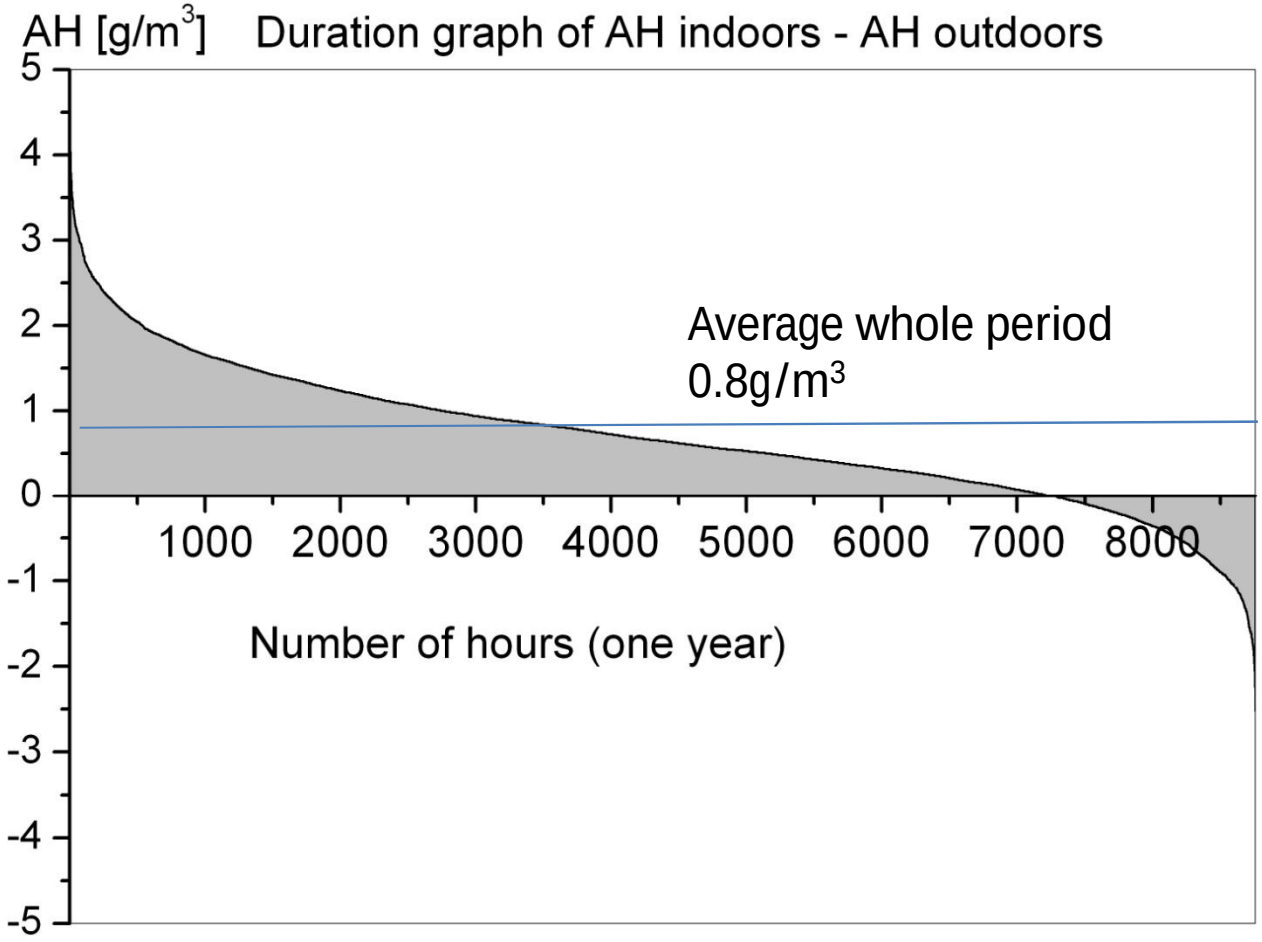
With adaptive ventilation (June 2010)



With adaptive ventilation (2009-2010)



With natural ventilation and conservation heating (2008-2009)

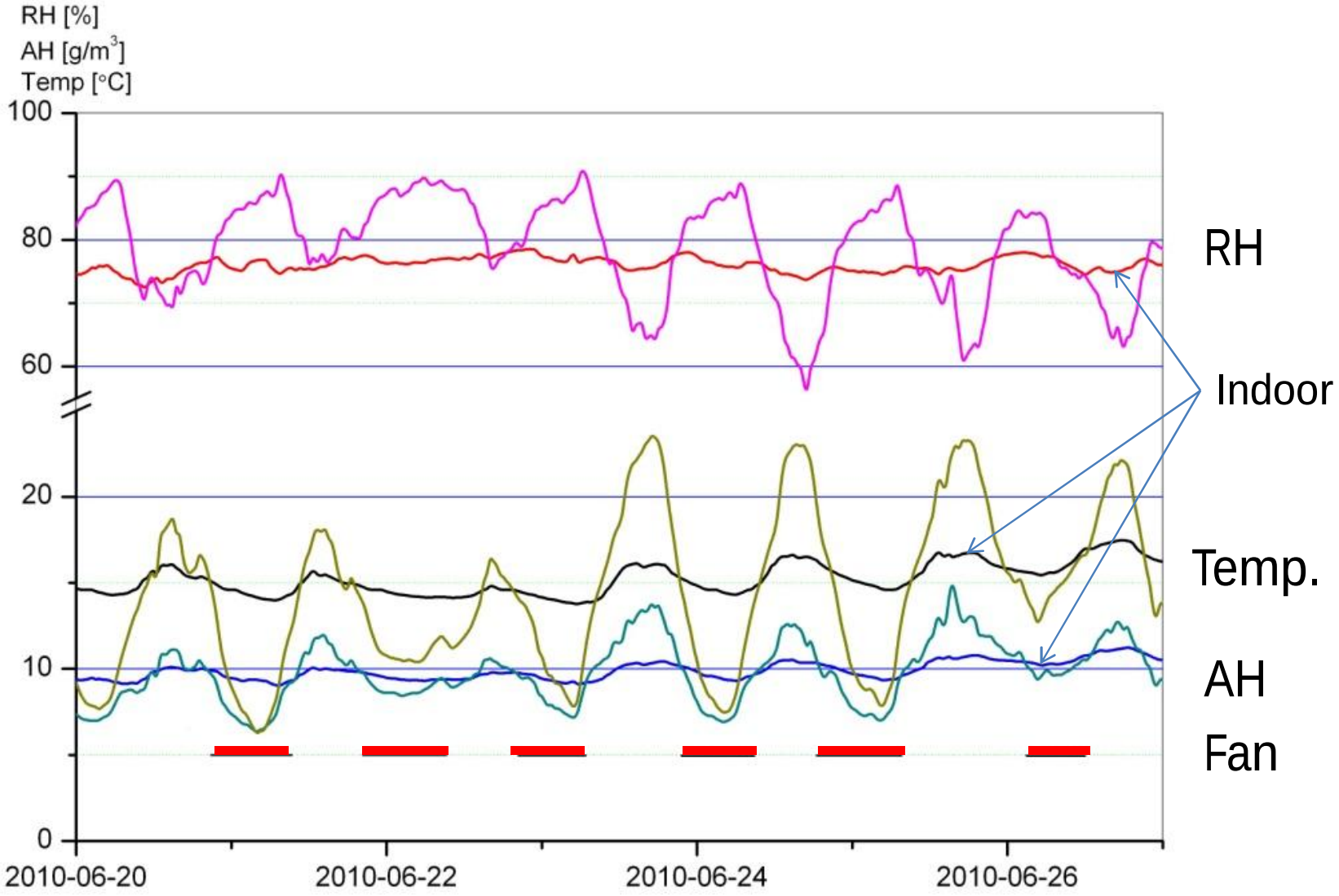


Mass balance

•Based on the ventilation air flow only and the actual difference in AH, around 1600 kg of water is removed from the building over one year.

• If we also take infiltration into account, which is quite high in this building, around 2800 kg of water would be removed, 800 kg would be added giving a net effect of around 2000 kg per year.

Variations in hygrothermal conditions during one week in June



Mould risk

$$\frac{RH}{RH_{cr}}$$

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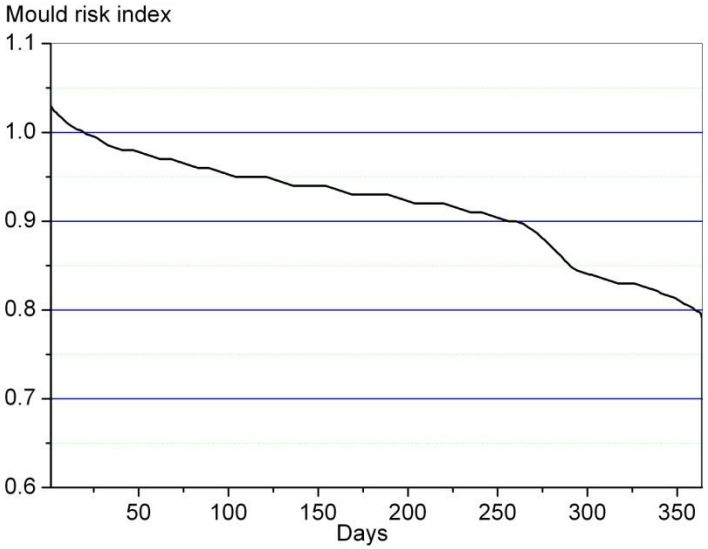

Conclusions

•Controlled ventilation has had a significant drying effect removing some 1600 kg of water in one year.

•The mould risk is low except two short periods.

•The effect on RH is small and often hard to see.

•Installation costs are low and energy costs are negligible in relation to other measures.

•The effect of the ventilation can be improved by increased fan capacity and improving air tightness to reduce leakage when the fan is not in operation.

•We need more research on the combined effect of humidity and temperature and on the long term effects of controlled ventilation.