Passive and active cooling in 3 PH row houses in DK.

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Climate change – is cooling needed?

Climate change means higher middle temperatures also in Denmark, esp. in late spring and summer. As people experience higher temperatures there is a growing need for user friendly summer comfort design.

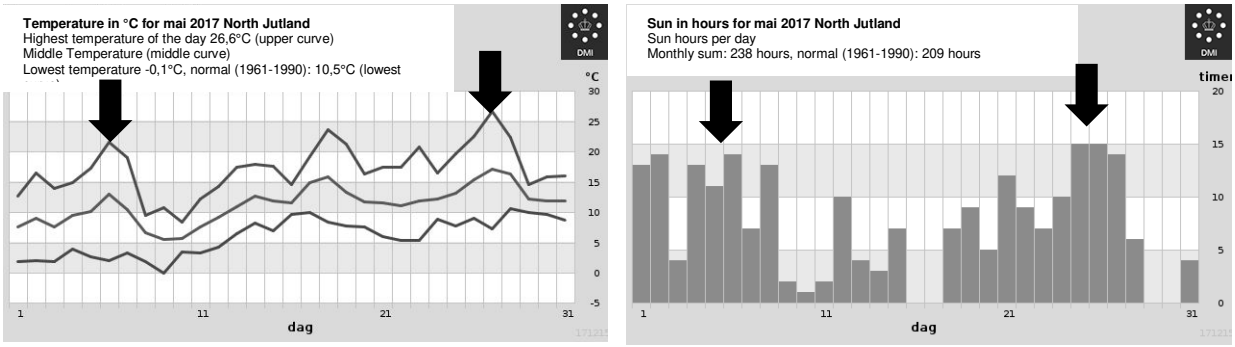

Figure 1: In Mai 2017 middle temperature peaks were approx. 9°C higher than long term middle. Solar hours peeked at the same time.

Summer comfort designs in 3 passive house projects in Northern DK

This paper compares the cooling effect of 3 different shading elements in combination with natural ventilation and night cooling in 3 PH row house projects in Northern Denmark. Extra costs for shading elements and 25% higher energy efficiency were compensated with a compact basic PH design. Energy consumption has been followed for a period of 3 years. Additionally, log data from an optional “active cooling system” in one row house (photo 3), is analysed.

The shading elements used are: an outside screen (Skive), a manually operated shutter element (Aabybro), a brise soleil (a fixed building shading profile - Nr. Halne)

The design ensuring cross natural night ventilation and mechanical night ventilation for a compact unit is analysed in PHPP (Mechanical ventilation is set to minimum air exchange). PHPP data analysis shows that a combination of shading elements and natural or mechanical night ventilation reduces the cooling load to a minimum.

Although the brise soleil solution achieves a better reduction of the overall frequency of overheating, the effect is not enough to meet the PH standard for summer comfort.

A combination of building shading, natural ventilation and an active back up cooling function as PH summer design has been chosen in the last project Nr. Halne. Its analysis is based on log data from the compact unit.

Figure 2: Shading in the selected PH house projects in DK.

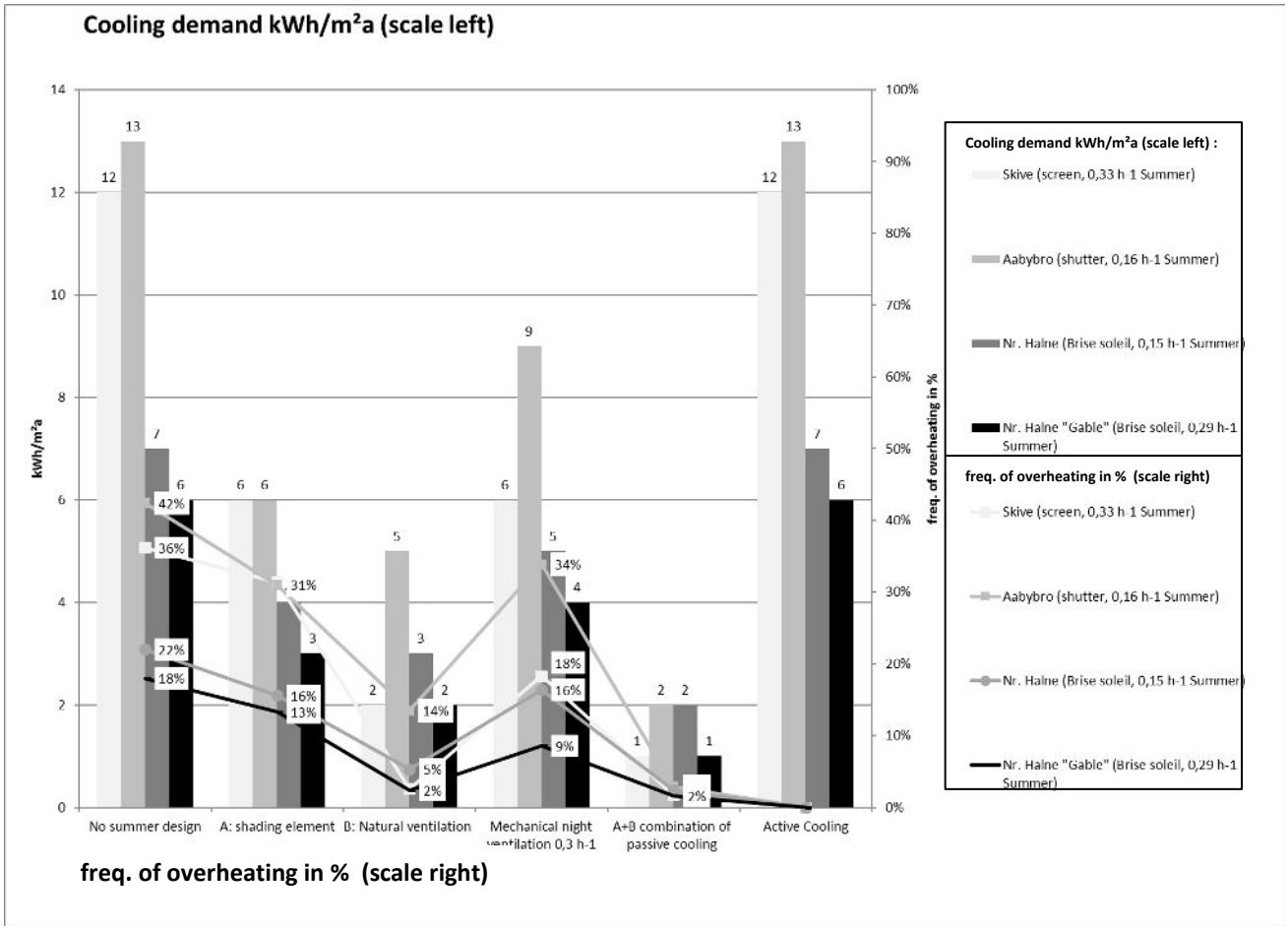

Figure 3: A brise soleil is designed to shade the solar angles, which cause most overheating. It provides a fixed cooling effect of approx. 3 kWh/m², which reduces the cooling demand by natural ventilation by approx. 50 %.

Lessons learned

Influence of user behaviour on energy consumption: One user chose a Room Set Temperature of 25°C instead of desired of 20°C. The mistake was simple to correct.

In a gable row house in Nr. Halne project the Room Set Temperature was set to 17°C, which activated the Automatic Active Cooling Function in summer. Figure 3 shows that natural ventilation at night instead of active cooling would have been sufficient, as outside temperatures were approx. 10°C lower than the desired room temperature.

Resume

PH criteria for user friendly summer comfort can be met using passive Cooling in DK. Shading systems cannot stand alone, but a combination of shading design and natural ventilation during night provides enough cooling effect. Active cooling is not necessary in northern Europe.