Wood as a Climate Buffer in a Supermarket

Authors : Kristine Nore, Alexander Severnisen, Petter Arnestad, Dimitris Kraniotis, Roy Rossebø

Abstract : Natural materials like wood, absorb and release moisture. Thus wood can buffer indoor climate. When used wisely, this buffer potential can be used to counteract the outer climate influence on the building. The mass of moisture used in the buffer is defined as the potential hygrothermal mass, which can be an energy storage in a building. This works like a natural heat pump, where the moisture is active in damping the diurnal changes. In Norway, the ability of wood as a material used for climate buffering is tested in several buildings with the extensive use of wood, including supermarkets. This paper defines the potential of hygrothermal mass in a supermarket building. This includes the chosen ventilation strategy, and how the climate impact of the building is reduced. The building is located above the arctic circle, 50m from the coastline, in Valnesfjord. It was built in 2015, has a shopping area, including toilet and entrance, of 975 m^2. The climate of the area is polar according to the Köppen classification, but the supermarket still needs cooling on hot summer days. In order to contribute to the total energy balance, wood needs dynamic influence to activate its hygrothermal mass. Drying and moistening of the wood are energy intensive, and this energy potential can be exploited. Examples are to use solar heat for drying instead of heating the indoor air, and raw air with high enthalpy that allow dry wooden surfaces to absorb moisture and release latent heat. Weather forecasts are used to define the need for future cooling or heating. Thus, the potential energy buffering of the wood can be optimized with intelligent ventilation control. The ventilation control in Valnesfjord includes the weather forecast and historical data. That is a five-day forecast and a two-day history. This is to prevent adjustments to smaller weather changes. The ventilation control has three zones. During summer, the moisture is retained to dampen for solar radiation through drying. In the winter time, moist air let into the shopping area to contribute to the heating. When letting the temperature down during the night, the moisture absorbed in the wood slow down the cooling. The ventilation system is shut down during closing hours of the supermarket in this period. During the autumn and spring, a regime of either storing the moisture or drying out to according to the weather prognoses is defined. To ensure indoor climate quality, measurements of CO_2 and VOC overrule the low energy control if needed. Verified simulations of the Valnesfjord building will build a basic model for investigating wood as a climate regulating material also in other climates. Future knowledge on hygrothermal mass potential in materials is promising. When including the time-dependent buffer capacity of materials, building operators can achieve optimal efficiency of their ventilation systems. The use of wood as a climate regulating material, through its potential hygrothermal mass and connected to weather prognoses, may provide up to 25% energy savings related to heating, cooling, and ventilation of a building.

Keywords : climate buffer, energy, hygrothermal mass, ventilation, wood, weather forecast
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