

Evaluation of overheating risks and passive cooling methods in low energy Swedish houses - Sammar Kassab & Salma Aljabri

Climate change is causing global temperatures to continuously increase impacting not only the environment, but humans and buildings as well. Due to the increase in temperatures, overheating in buildings has become a serious issue causing various health problems ranging in severity from productivity decline and sleep reduction to more fatal health hazards specifically in people more vulnerable to heat stress.

The European Commission has set certain goals to lower harmful emissions in the coming years by using more energy efficient buildings since the building sector is responsible for more than 40% of the total emissions. Swedish governmental organizations have also been striving to achieve these goals over the last decade by building low-energy and passive houses that rely on using heavy insulation and increasing solar gains. These measures make the building more airtight with minimal heat losses which in turn would minimize the need for heating during the winter seasons but also increasing the problem of overheating during the summer.

A review of relevant research about the definition of overheating, its possible causes, and the health impacts on human health was presented. Further exploration was also conducted to gain more knowledge about past heatwaves and future climatic conditions as well as passive cooling methods that could be applied to buildings and new constructions to reduce overheating.

The study is divided into two parts, the first part includes an analysis of overheating occurrences during the months of July and August of the year 2018. Using temperature measurements acquired from a total of 150 Swedish low energy detached houses, data was analysed according to three Swedish and international standards which set temperature recommendation limits for the summer period. The results showed that temperatures exceeded 26 °C in more than 80% of the households and is more frequent in dwellings located in bigger cities.

The standards and recommendations used in the study are by CIBSE (chartered institution of building services engineers in the UK), FEBY (Swedish forum for low energy and passive houses) and Boverket (The Swedish national board of housing). CIBSE considered the annual occupants' presence and showed higher overheating occurrences when compared to FEBY which allowed temperatures to exceed 26 °C during April and September for 10% of the occupied time. The third recommendation used in the analysis was the suggestion of Boverket which only sets a single temperature threshold limit of 26 °C regardless of occupancy or the specification of a period of time. New approaches were also investigated, including the analysis of the duration of overheating episodes.

The second part of the study includes a case study of one of the investigated dwellings located in Sundsvall, Sweden. Using the building performance simulation program IDA-ICE, a simulated model of the building under realistic weather conditions was used to match the actual conditions of the dwelling. Thereafter, the model was used to determine the possibility of using passive cooling measures and their efficiency in reducing indoor overheating. The final results revealed that opening windows for long periods especially at night, as well as cross-ventilated open windows can significantly reduce overheating to minimum thresholds.