Solar Sustainable Heating, Cooling and Ventilation of A Net Zero Energy House

O.B. Kazanci[1], and M. Skrupskelis[1]

[1]DTU Civil Engineering, Technical University of Denmark

ABSTRACT

Buildings play a key role within the 20/20/20 goals of the European Union since they consume 40% of the energy within the member states (European Commission, 2010).Therefore an urgent and efficient transition is necessary in order to reach to the almost "passive house" level.
Present Masters project, Solar Sustainable Heating, Cooling and Ventilation of A Net Zero Energy House, consists of the entire HVAC (Heating, Ventilation, and Air Conditioning) concerns of the DTU's house, the FOLD, for the competition Solar Decathlon Europe 2012. Yet, this Masters project extends further in order to contribute to the future low energy housing targets and challenges. This is only possible with precise dimensioning and excellent interplay within the components that comprise the house.
In this project, various innovative options are being investigated, namely, utilization of ground as a heat source/sink via a heat pump and for free cooling when possible, photo-voltaic/thermal (PV/T) panels and phase change materials (PCM).
PCM, if installed in the house, increases thermal mass of the building. Increasing building thermal mass is particularly relevant for a small individual houses, since the weight of the structure has tendency to decrease (wooden framework houses). Higher thermal mass means smaller temperature drift in the building, which is directly related to energy consumption for heating and cooling purposes.
Also one significant aspect is that the heating and cooling of the house will be addressed by the embedded pipe system rather than a conventional system with ventilation taking care of these needs. In this case, ventilation is only used in order to adjust the humidity and remove sensory pollution in order to provide a comfortable indoor environment. The relevant values for the system have been investigated by means of hand calculations and by means of commercially available softwares.
For example, a combination of embedded pipe system and phase change material was simulated by dynamic building simulation software. The results show reasonable energy saving, up to 30%, for cooling season in Spain, using embedded pipes and PCM system compared to only embedded pipe system.
The house is designed to comply with the EU's 2020 goals of 75% less energy consumption based on 2006 values (European Commission, 2009). Yet, this house is self-sufficient from the electricity production/consumption point of view. Once this house is built, tested and optimized at a single-family house scale, further possibilities can be investigated in order to apply a similar strategy to the entire building block. Once this is achieved, it will lead to a considerable amount of primary energy savings and consequently avoided/reduced greenhouse gas emissions.

REFERENCES

European Commission. (2010). *Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings.* Brussels: European Union.
European Commission. (2009). *Low Energy Buildings in Europe: Current State of Play, Definitions and Best Practice.* Brussels: Europen Union.