Predicting performance of Passive Houses: A study on the first Irish Passive House

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1 Introduction

Analysis of the performance of Passive Houses has been carried for many years in Europe. Calculation tools such as PHPP have been shown to successfully predict the annual energy demand. Monitoring studies have also shown that comfortable internal conditions can be achieved throughout the year. [Schnieders and Hermelink, 2006].

This paper analyses the thermal behaviour of a Passive House using a ten minute time interval. Both measured and calculated results are compared for a period of two months, and analysis of the accuracy of the calculations and possible applications of the predictions on Passive Houses are discussed.

2 Description of the house and the computer model

The first Irish Passive House in Ireland was built in Co. Wicklow, in 2005. The envelopes component U-values are 0,1 W/(m²K) for roof, walls and floor, 0,6 W/(m²K) for doors and 0,74 W/(m²K) for windows. Systems installed in the house include mechanical ventilation with heat recovery, solar flat plate collectors and a pellet boiler. The house was modelled with the DesignBuilder interface and calculations were performed with EnergyPlus dynamic simulation tool. House geometry, zone distribution, construction details, internal gains, occupancy rates and systems were all modelled to match reality as closely as possible.

Figure 1: Pictures of the house

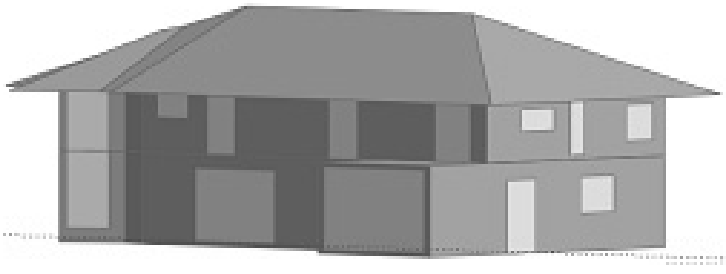

Figure 2: Picture of the simulation model

3 Analysis and results

Weather conditions including solar radiation, wind speed, wind direction, humidity, external temperatures as well as the internal temperatures of 7 rooms inside the house were measured every 10 seconds. This data was aggregated, averaged and recorded every 10 minutes. The weather data recorded was used as input for the simulation tool, and the dynamic calculations were performed with a 10-minute interval.

Measured results have been compared with simulation results for the first two months of 2006. Results show predicted temperatures around a degree higher than reality. Distribution of the temperatures around the house is predicted with reasonable accuracy, showing south facing rooms having slightly higher temperatures. Figures 3,4 present results of measurements and calculations for a number of hours during 13th February 2006.

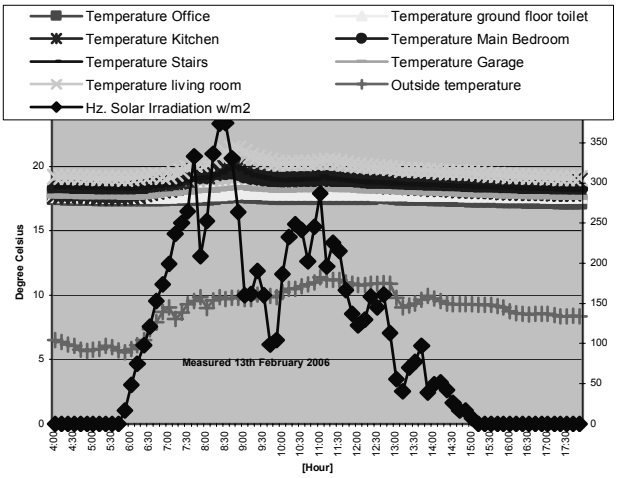

Figure 3: Measured values for 13th Feb 2006

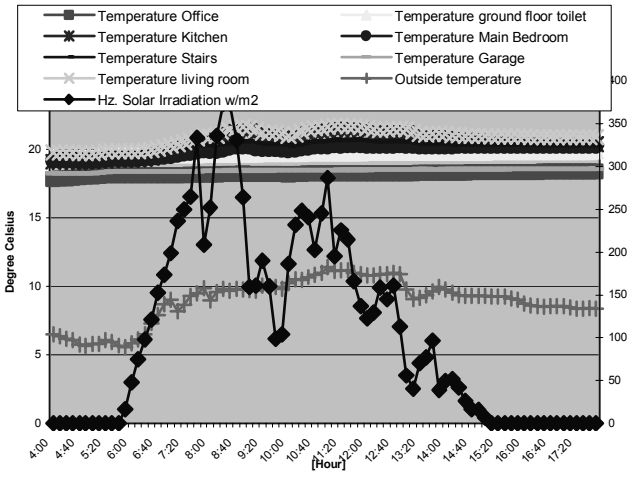

Figure 4: Calculated values for 13th Feb 2006

4 Conclusions

The EnergyPlus simulation tool predicts slightly higher temperature for the Wicklow Passive House. The main reasons for this difference might be heat recovery ventilation efficiency, infiltration rates, and internal gains, where each of these features was included in the dynamic model using simplifying assumptions. The simulation tool proves useful when calculating the immediate response of the different rooms to solar gains. Results show similar response in the measured and calculated temperature rises for south facing rooms with high glazing areas. This aspect could prove useful in assessing the risk of overheating in Passive Houses, especially in southern Europe.

5 References

[Schnieders and Hermelink, 2006] CEPHEUS results: ***measurements and occupants´ sadisfaction provide evidence for Passive Houses being an option for sustainable building***. Energy Policy, 34, 151-171, 2006