Report Summary: Building Physics Analysis of the University of Cambridge Primary School

Ramaraj Sundraraj, 1/10/2015 – 25/5/2016

Overview: The project involves an analysis on U-values (effectiveness of particular materials as insulators), ventilation schemes and underfloor heating in an unoccupied classroom in the University of Cambridge Primary School.

Aims:
- Investigate the differences between in-situ U-value measurements & theoretical values,
- Test mixing and displacement ventilation schemes in a classroom to combat overheating and for night-cooling respectively, and
- Investigate the uniformity of temperature provided by the underfloor heating system.

Process/methodology: The project involves setting up thermistors, thermocouples and data loggers to measure U-values and to capture the temperature distributions of the classroom caused by ventilation changes or by underfloor heating.

Results: It was found that the U-value of the window was $0.5W/m^2K$ less than the theoretical value (1 compared to $1.5W/m^2K$). This indicates there is more insulation than expected. Mixing ventilation (which harnesses the underfloor heating to function better) showed promising results in cooling the classroom and providing a warm uniform temperature. Displacement ventilation and opening the window (both of which use no energy input) were equally efficient in night-cooling the classroom. The underfloor heating systems had a significant discrepancy in temperature uniformity on the left side of the classroom.

Recommendations: Increase the use of mixing and displacement ventilation to cool the classroom. Combat overheating on the left side of the classroom by opening windows to ensure occupant comfort. Conduct in-situ U-value measurements periodically in the buildings in general.

Conclusions: The aims of the project have been met; however, more testing would be needed in an occupied classroom to verify the results obtained in the unoccupied scenario. (The effect of this would depend upon the number of occupants; if the same as currently occupied classrooms, the results above are expected to remain valid due to the larger effect of the underfloor heating. Either way, additional heat sources would enhance mixing ventilation, and if the room did get too hot, the underfloor heating could be turned down for ideal mixing conditions).

About you: *Ramaraj Sundraraj, Engineering, Masters in Engineering, Scrabble enthusiast.*

Motivation: *As part of the IIB Engineering course and also to learn more about building physics.*

Personal outcomes from project: *Ability to analyse large amounts of data and use basic physics to estimate building physics parameters in different scenarios.*

Vision: *I hope that the project would shed some light on U-value discrepancies and the implementation of mixing and displacement ventilation schemes in all classrooms.*

What's next?: *Working for a construction-based company, United Engineers Malaysia (UEM), in Malaysia.*