

Evaluation Of Thermal Comfort In Selected Experimental Laboratories Using Computational Fluid Dynamics

Prepared by: Jim Yang Yexin

ABSTRACT

Many of the university students spent most of their time indoors. Studies have shown that the indoor thermal environment affects the learning effect and health of the occupants and at the same time the energy consumption of buildings. This paper evaluates the thermal environment of an air-conditioned laboratory and a naturally ventilated workshop in a tertiary educational institution located in Malaysia using computational fluid dynamics (CFD). A pilot survey was conducted to collect the required information such as initial conditions and boundary conditions for the development of CFD models. CFD models of the laboratory and workshop were constructed and simulated for different cases. The laboratory was simulated by varying the occupancy levels whereas the workshop was simulated for two different weather conditions. Results showed the average air temperature in the laboratory was affected by the occupancy level. Meanwhile, the average air temperature in the workshop was affected by the weather conditions as a sunny weather has a higher average air temperature compared to a cloudy weather. However, from the simulations outcomes, both the occupancy level and weather condition did not affect the average air velocity in the laboratory and workshop. The average air temperatures and average air velocities of both locations were outside the recommended ranges specified in MS 1525 (2007). The predicted mean vote (PMV) and predicted percentage dissatisfied (PPD) indices showed that occupants were thermally uncomfortable and dissatisfied. Calculations of operative temperatures showed that occupants in the laboratory preferred a warmer environment whereas occupants in the workshop preferred a cooler environment. Comparison of the simulation results and the objective assessments of a previous study showed that the air temperatures were in good agreement with a percentage difference of below 10 %. However, the air velocities differed by 24.38 – 59.00 % due to the limitation of CFD settings. Recommendations were made to regulate the inlet air temperature of the laboratory and increase the air velocity of the workshop in order to provide a more comfortable thermal environment to the occupants.