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Abstract (Doctor)

Title of Thesis	A Study on Adaptive Thermal Comfort in University Dormitories. Effect of Nationality
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Approx. 800 words

Our contemporary world faces unprecedented global problems – environmental, geopolitical, societal, economic and technological. Excessive and insensible energy use on a global scale is one of the major contributors to the complex environmental issues. Any local effective measure for energy conservation and its efficient use can contribute to the solution. One way to limit energy use is through implementing adaptive thermal comfort. Allowing building occupants to control and connect back to their immediate thermal environment and, to adapt to it, eventually affects the energy consumption of the building itself. Providing comfort is complicated and it is the outcome of a flexible system including 1) the occupant; 2) the building; 3) the indoor microclimate and 4) the outdoor climate.

The current thesis is focused on investigating the behavior and subjective preferences for their indoor environment of Japanese and non-Japanese students living in university dormitory buildings under Japanese climatic conditions. The major initial objective is to determine what does comfort mean in terms of temperature range for Japanese and non-Japanese people; to compare the differences and, to understand how tolerant the occupants are to their environment. We expected to observe 1) difference in comfort temperatures between Japanese and non-Japanese students in summer as well as in winter; 2) that Japanese comfort vote will fall within the current recommendations for summer and winter in Japan; and 3) that Japanese students will be more tolerant to their environment in both seasons as it is native to them.

Dormitory buildings were selected for conducting the research as 1) they are a unique combination of a residence and office; 2) they are under-investigated in Japan in terms of adaptive thermal comfort; 3) they are for temporary multinational occupancy and, can reveal the differences between Japanese and non-Japanese students; 4) they are expected to need major refurbishment in the recent years.

We planned and conducted a field survey in the summer and winter of 2017 – 2018 in two university dormitory buildings in Toyohashi University of Technology – the international dormitory (Kaikan) and the Global Students Dormitory (GSD).

Subjective votes were collected through a traditional paper questionnaire. Simultaneously, measurements of physical parameters of the indoor and outdoor environment were conducted and the two data-sets were linked. The correlation of the subjective neutrality and comfort were investigated in relation to nationality

The study revealed that for both observed groups, in summer, the subjective neutrality and comfort was related to outdoor climate conditions, but in winter it was strongly disconnected from the outdoors.

For both Japanese and non-Japanese students, thermal responses were strongly correlated to one another, where feeling warmer resulted in increase of subjective comfort in winter and decrease in summer. In winter, feeling warmer led to decrease in the desire to warm up the indoor environment, while in summer it led to the desire to cool it down. Nevertheless, voted thermal acceptability in both seasons was invariably above 85% which can be explained with the high level of personal control.

During summer, the recorded indoor humidity was very high (71%), while in winter it was very low (47%). However, in both seasons it did not affect the thermal sensation vote. For both Japanese and non-Japanese students, thermal sensation was significantly determined only by the indoor temperature. The effects of clothing and activity were also negligible both in summer and in winter.

The summer neutral indoor temperature could be estimated as 26°C for Japanese students and as 25°C for non-Japanese. However, the highest probability of voting neutral for Japanese students was only 70-75% and it was estimated within 24~28°C indoor temperature. For non-Japanese students it's above 80% within the same temperature range.

The winter neutral indoor temperature could be estimated as 21°C for Japanese students and as 22°C for non-Japanese. However, the highest probability of voting neutral for Japanese students was only 65% and it was estimated within 19~22°C indoor temperature. For non-Japanese students it's 75% within 19~24°C indoors.

Japanese students were notably more sensitive to their indoor environment as compared to non-Japanese ones in both seasons. The summer comfort temperature for both groups could be estimated as 26°C and, in winter it is 20°C for Japanese and 22°C for non-Japanese.

For both Japanese and non-Japanese students, the yielded predicting models from the survey deviated from the models in the current international standards. In addition, the voted and the estimated neutrality and comfort in the study were mostly below the recommended minimum indoor temperature in summer and, above the recommended maximum indoor temperature in winter in Japan. As the recommendation is set considering the energy conservation, it is reasonable to further investigate how to make it possible to adjust the subjective neutral and comfort temperatures without compromising personal comfort.