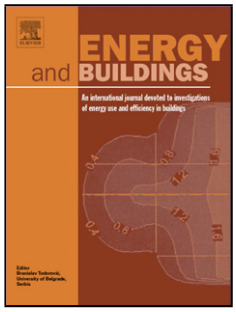

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PII: S0378-7788(17)31021-6
DOI: http://dx.doi.org/doi:10.1016/j.enbuild.2017.05.028
Reference: ENB 7609

To appear in: *ENB*

Received date: 23-3-2017
Revised date: 10-5-2017
Accepted date: 12-5-2017

Please cite this article as: Dayi Lai, Xiaojie Zhou, Qingyan Chen, Modelling Dynamic Thermal Sensation of Human Subjects in Outdoor Environments, Energy and Buildingshttp://dx.doi.org/10.1016/j.enbuild.2017.05.028

Modelling Dynamic Thermal Sensation of Human Subjects in Outdoor Environments

Dayi Lai[1], Xiaojie Zhou[2], Qingyan Chen[1,2,*]

[1]School of Mechanical Engineering, Purdue University, West Lafayette, IN 47907, USA

[2]Tianjin Key Lab of Indoor Air Environmental Quality Control, School of Environmental Science and Engineering, Tianjin University, Tianjin 300072, China

*Corresponding author: Qingyan Chen

Phone: +1-765-496-7562, Email: yanchen@purdue.edu

HighlightsA thermal sensation model was developed for dynamic outdoor thermal environments.

Thermal load, mean skin temperature, and change rate of mean skin temperature are the three predictor variables.

The model was validated for predicting the thermal sensation of human subjects in different regions.

Abstract

Outdoor spaces provide the growing urban population with social, health, environmental, and economic benefits. A thermal comfort model is needed to aid in the design of attractive urban outdoor spaces. In an outdoor environment, a person's thermal comfort changes with the dynamic weather conditions. However, most of the outdoor thermal comfort models in the literature are for steady-state conditions. To develop a dynamic thermal comfort model, this study observed the responses of 26 human subjects from West Lafayette, Indiana, USA, and Tianjin, China, to a wide range of outdoor thermal environments. The study monitored the subjects' skin temperatures, recorded their thermal sensations, and measured several outdoor environmental parameters. Analysis of the test data showed that the thermal load, the mean skin temperature, and the change rate of the mean skin temperature of the subjects tested were the most important parameters affecting their thermal comfort in the outdoor spaces. These three parameters were integrated as predictor variables into a comfort model for predicting the outdoor thermal sensation. The model uses the thermal load to evaluate the thermal environment, and the mean skin temperature, and its change rate to consider dynamic changes in the thermal state of the human body. The validity of the model developed in one region was tested with the use of data obtained from the other region.

Keywords: Thermal comfort model; Outdoor spaces; Thermal load; Human subject test; Dynamic thermal sensation