Time-dependent Thermal Comfort Variables

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Abstract

Existing research on relationship of thermal comfort to environmental and personal factors focused on steady-state conditions. However, the comfort state of people depends also on transients in which factors change in time. This research study aims at identifying and determining a method of quantization of the effectiveness of transient and non-uniform environmental and personal variables in relation to a three-dimensional human body. The addressed problem, which is reducing energy consumption while increasing thermal comfort, has long been the challenge of architecture and is valid for all types of occupied spaces.

Mechanical systems design involves comfort standards such as ASHRAE Standard 55 and ISO 7730, which are based on steady-state conditions. Therefore, mechanical systems are not designed nor optimized to respond to transient and nonuniform conditions which occur in occupied spaces. By focusing on alternative space design and air-conditioning operation, the primary expected outcome of this research project is an optimized method to conserve energy while improving thermal comfort under transient conditions.

In this study, controlled experiments will be conducted in realistic office setting with human subjects. Six parameters including air temperature, relative humidity, air velocity, mean radiant temperature, clothing and activity levels will be controlled and changed in time. Their relationship to human body thermal state will be assessed through occupant surveys and measured data. Correlation and regression analysis will be conducted between the six parameters and thermal comfort state of subjects.