

Strategy and Practice of Adaptive Thermal Comfort in Low Energy Buildings

EBC ANNEX 69

Reducing energy use and providing comfortable indoor environments for occupants are both key objectives of the building sector globally. However, establishing the appropriate balance between these often competing issues is challenging. Is it possible to achieve thermal comfort in buildings without increasing energy use? To answer this, this project is focussed on:

- creating a scientifically based explanation of the underlying mechanism of adaptive thermal comfort for people in buildings, and
- the application and evaluation of the thermal adaptation concept to reduce building energy consumption through design and control strategies.

The concept of adaptive thermal comfort is not new, but there are still existing problems to be solved in this field of research:



In air-conditioned buildings, personal control systems play an important role in thermal adaptation.

Source: Edward Arens, University of California at Berkeley

PROJECT OBJECTIVES

- 1 establishing a database with quantitative descriptions of occupant thermal adaptation responses;
- 2 developing new or improved indoor thermal environment criteria based on the adaptive thermal comfort concept;
- 3 providing a basis for the creation or revision of indoor environment standards;
- 4 proposing passive building design strategies to achieve thermal comfort with low energy consumption;
- 5 providing guidelines for new cooling and heating devices based on perceived / individual control adaptation.

- Although the adaptive effect has been observed by many researchers, the mechanism of the adaptive process is still unclear, especially the psychological and behavioural influences.
- The thermal adaptation responses of people in diverse climatic regions can be quite different, which may result in different building design strategies and indoor environment solutions. Current understanding of occupants' adaptive responses in different climate regions is still limited.
- Apart from purely free-running buildings or air-conditioned buildings, mixed-mode buildings are the most common type. In existing standards there are no evaluation criteria for this kind of building. Most clients refuse to accept low energy building design with an indoor thermal environment outside the comfort range defined in current standards.

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) was established as an autonomous body within the Organisation for Economic Co-operation and Development (OECD) in 1974, with the purpose of strengthening co-operation in the vital area of energy policy. As one element of this programme, member countries take part in various energy research, development and demonstration activities. The Energy in Buildings and Communities Programme has co-ordinated various research projects associated with energy prediction, monitoring and energy efficiency measures in both new and existing buildings. The results have provided much valuable information about the state of the art of building analysis and have led to further IEA co-ordinated research.

EBC VISION

By 2030, near-zero primary energy use and carbon dioxide emissions solutions have been adopted in new buildings and communities, and a wide range of reliable technical solutions have been made available for the existing building stock.

EBC MISSION

To accelerate the transformation of the built environment towards more energy efficient and sustainable buildings and communities, by the development and dissemination of knowledge and technologies through international collaborative research and innovation.

ACHIEVEMENTS

This project produced a database with a user interface including information about human thermal reactions, together with occupant behaviour and building energy consumption, a model and criteria for the application of adaptive thermal comfort in buildings, guidelines for low energy building design based on the adaptive thermal comfort concept, and guidelines for personal thermal comfort systems in low energy buildings.

The following reports have been published as the official project deliverables:

- Development of the ASHRAE Global Thermal Comfort Database II
- Models and Criteria for the Application of Adaptive Thermal Comfort in Built Environment
- Guidelines for Low Energy Building Design Based on the Adaptive Thermal Comfort Concept
- Guidelines for Personal Comfort Systems in Low Energy Buildings

Project duration

Completed (2014 - 2022)

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Further information

www.iea-ebc.org