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Experimental Investigation on Thermal Comfort Quantification

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***Abstract*: Research on occupational behavioral adaptation in India are limited, the present investigation was focused on the indoor room temperature along with the thermal comfort quantification by varying clothes. The adaptive idea that predicts that contextual factors for occupants' comfort as a whole, but also for their health and productivity. The research aims to assess the thermal environmental conditions and evaluate the thermal adaptation for occupants of these room. The test is done in the room and is concentrated under seven conditions. Thermal comfort depends on the clothing index and activity performed by occupants.**

***Keywords*: Occupant's, Behavioral adaptation, Thermal Comfort, Clothing Index.**

1. Introduction

The current standards of comfort are designed to optimize the thermal acceptability of indoor environments. Unfortunately, they have tended to require energy-intensive environmental control strategies and often exclude thermally variable solutions, such as many climate-responsive and energy-conserving designs, or innovative mechanical strategies that allow for personal control. These standards (ASHRAE 1992, ISO 1994) recommend a narrow temperature band to be spread uniformly over time and space. They are based on a static thermal comfort model that views the occupants as passive recipients of thermal stimuli guided by the dynamics of the body's thermal equilibrium with its immediate environment and mediated by autonomous physiological responses.

Growing frustration with static temperatures of comfort and the consequent environmental damage caused by energy resource mismanagement has spurred interest in a variable indoor temperature standard to complement current standard 55. A variable indoor temperature level, based on the adaptive thermal comfort model, will be especially important for naturally ventilated buildings and other circumstances where occupants of buildings have some degree of indoor climate control.

2. Adaptive principle

The adaptive theory of thermal comfort that gives the idea that people play a semantic role in creating their own thermal preferences. This is achieved either by interacting with the environment or modifying their own behaviour or by changing their expectations and thermal preferences (dear 1998) due to contextual factors. There are three levels identified for thermal adaptation: physical, physiological, and psychological (Nikolopoulou & Steemers 2003). It also claimed that the relationship between physical and psychological environment. This section investigates the adaptive model using indoor space and key adaptive measures influencing thermal sensation in cabin interior space.

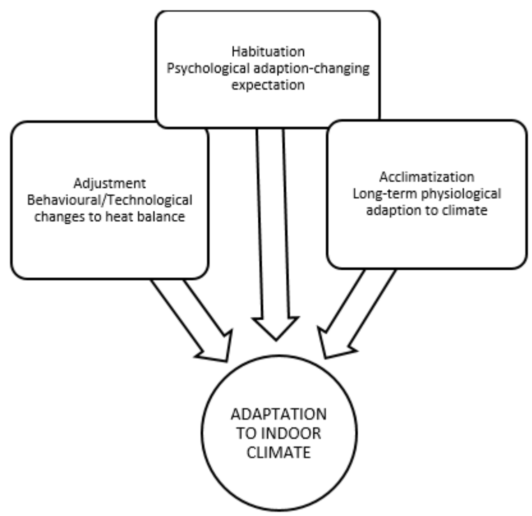

Fig. 1. Three components of adaptation to indoor climate

According to this understanding, comfort, and discomfort are dynamic in character, and it is therefore unlikely that a "comfort zone" can adequately be described by means of a temperature interval only, the time dimension will also need to be incorporated in its definition. Indeed, once Thermal comfort is seen as a dynamic system, time becomes an essential component in understanding the comfort processes. It is the context in which all adaptations occur, and it, therefore, has a fundamental place in the adaptive model. The set of conceivable accommodative actions in response to warmth or coolness is also classified into 5 categories:

1. Control the speed of internal heat generation

2. Control the speed of body heat loss
3. Control the thermal surrounding
4. Choosing a special thermal surrounding
5. Modifying the body's physiological comfort conditions

3. Methodology

Two principal methodologies used in this study are questionnaires and physical Measurements.

A. *Questionnaires*

The main methodology of the survey chosen during this analysis is that the form, to know the occupant's perception of the thermal condition in existing transmutation areas in buildings, then meshing the gathering information with measure result. The data about occupants' perceptions include thermal sensation, thermal preference, and thermal adaptation. In recent years, thermal sensation associate degreed adaptation has become an important issue in studies of indoor and outside thermal environments (Lin 2009).

During this study, the questionnaire is used as this technique would directly obtain the response of the occupants. Subjective and objective variables will be separated into the form survey. The target variables

Include gender, age group, and occupation. The subjective variables include satisfaction of the occupants with their thermal environment, and classes related to health of the occupants. The second segment asks subjects to rate their thermal satisfaction, their sensation and their preferences. Thermal satisfaction varies from very low to very good, to around 5 degrees. Thermal sensation is measured on the scale of ASHRAE 7-point thermal sensation vote (TSV). (i.e., -3 cold, -2 cool, -1 slightly cool, 0 neutral, 1 slightly warm, 2 warm, and 3 hot). The thermal preference can be determined by totally different thermal comfort adjustment scales required by the occupant.

B. *Physical Measurements*

Physical measurement can be an ancient and important step in gathering knowledge about environmental conditions. The four basic environmental variables which define the thermal environment of the participants are air temperature, radiant temperature, humidity and speed of air movement. Thermal environment knowledge is gathered by measure strategy. The aim and objectives of the experiments are:

1) To quantify the thermal atmosphere in indoor areas and mix the results with form to research participant's thermal perception in indoor areas.
2) To determine the varying internal and external thermal conditions found in the indoor area.

Table 1
ASHRAE seven points thermal sensation scale (ASHRAE Standard 55 2004)

Cold -3	Cool -2	Slightly cool -1	Neutral 0	Slightly warm 1	Warm 2	Hot 3

4. Clothing

Clothing is an important human need with several functions. The selection of clothing is predicated on many factors like personal desires and therefore the particular application; which are user dependent. However, people's preferences can also be dynamic with seasons, environment, age and sort of activity (Anand 2003). To the wearer, comfort can be defined as one method for evaluating clothing efficiency. In this sense, clothing designers and fabric engineers should find clothing comfort as an aspect of quality that contributes to overall clothing efficiency and user satisfaction (Hatch 1993; Mukhopadhyay and Midha 2008). People using similar clothing, within the same physical setting may experience different comfort levels.

A modifier concept has also been developed, suggesting that the wearer sieves a degree of comfort through the physical and psychophysiological elements using internal personal modifiers. These may include: personality (like lifestyle, preferences),

5. Experimental test room

The test room is the size of L × H × W = 23 feet × 9 feet × 11 feet with a nearly cubical shape. In the room 1 Ton Air Conditioner (AC) is installed and a window on opposite of the entrance wall owing to low height of the room, and ceiling fan is also installed.

Fig. 5. Experiment room

And experiment is done under 4 student in which we have selected 3 clothing insulation at 3 different time slots

3 Clothing Insulation

1. Shirt + Jeans
2. T-shirt + Jeans
3. Shirt + Trouser

3 Time Slots

1. 9:00 AM TO 9:30 AM
2. 2:00 PM TO 2:30 PM
3. 4:00 PM TO 4:30 PM

In this experiment we selected 7 conditions, and it takes half an hour for each condition.

1. Natural ventilation
2. Only fan
3. Only AC
4. Fan with AC
5. Natural ventilation with AC
6. Natural ventilation with FAN and AC
7. Natural ventilation with FAN

6. Result

The student who respond ±2 and ±3 are declared uncomfortable, who are respond to ±1 and 0 are declared comfortable. It was observed that the most uniform pattern of temperature observed when both fan and AC kept ON condition.

7. Conclusion

In this paper we discussed about the seven conditions from that we observed that clothing insulation play a vital role and uniform pattern of temperature was observed in Fan with AC.

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