A FIELD STUDY OF DRAUGHT COMPLAINTS IN THE INDUSTRIAL WORK ENVIRONMENT

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INTRODUCTION

Surveys of the working environment shows that draught is a common cause of complaints of occupants in offices and in industrial spaces [1,2]. Persons, especially working in cool or cold industries, often complain of draught. Based on field measurements and human subject experiments, a model to predict the number of occupants dissatisfied due to draught has been established, valid for sedentary people dressed in normal indoor clothing [3]. However, compared with office employees, industrial workers often perform work at an increased activity level and they wear clothing ensembles that differ from normal indoor clothing. Also, in many industrial spaces manufacturing procedures require that the temperature at the work place be kept well below usual comfort temperature. Therefore, the comprehensive knowledge of draught in office environments and its influence on man is not valid in industrial spaces. The purpose of this study was to survey the effect of some personal and environmental parameters on the employees' sensitivity to draught in different industrial spaces. This was done as an introduction to an investigation of human sensitivity to draught working at moderate metabolic rates in a cool environment.

METHOD

Two different questionnaires were distributed among employees in nine industrial spaces. Measurements were made of air temperature, *air* velocity and parameters characterizing the air velocity fluctuations. The investigated industrial spaces comprised a printing house, large-scale kitchens, a fresh food storage facility, fish processing plants and an iron manufacturing plant. One retrospective questionnaire itemized the general activity level, the thermal environment and the subjective cause of draught complaints. In addition, a shorter questionnaire to be filled in during the measurements was distributed. This questionnaire listed the immediate activity level, the thermal sensation, marked on a seven point scale, and an immediate, binary draught rating. The retrospective questionnaire was completed by 224 persons and the short questionnaire by 100 persons.

RESULTS

On comparing the questionnaires completed by persons working at low (4-20°C) or high (20-25°C) average air temperatures it was found that workers in low temperature spaces more often complained of draught and cold than people working in higher temperatures. In an earlier study draught is defined as an unwanted, local cooling of the skin caused by air movements [3]. The measurements of airflow characteristics documented, supplemented by the questionnaires, that air movements in cool environments most often were determined by the activity in the room, e.g. opening of gateways to the outdoor, and in the warm environments by *air* terminal devices located in the spaces.

In figure 1 the percentage of people feeling draught as a function of their thermal mean vote is shown. The figure is based on the short questionnaire. The figure shows that persons feeling cool or slightly cool

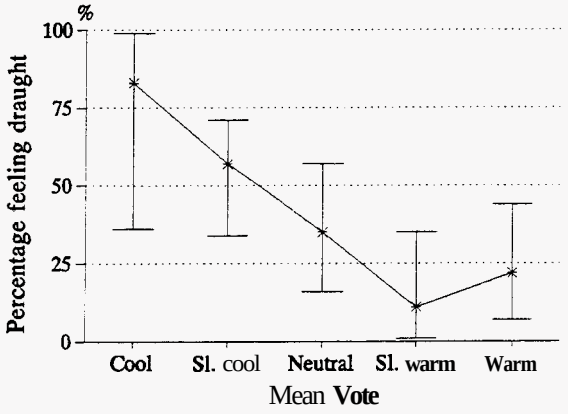

Figure 1. Percentage of persons feeling a draught as a function of their thermal mean vote. Around the observed values are shown the 95% upper and lower confidence limits.

perceived the air movements as being more unpleasant than those feeling neutral or warm. The thermal comfort level therefore seems to be an important factor for the human sensitivity to draught. It is often assumed that human sensitivity to air movements is less when working at a high activity level. This implies that the person exposed to air movements is feeling warm as a result of his high metabolism. If, for instance, a person is working at a moderately high activity level in a cool environment, he may feel cool or cold and therefore his sensitivity to draught will be increased compared with a thermally neutral person. The questionnaires indicate that the general thermal comfort level is of more significance than the activity level for the human sensitivity to draught.

Fanger et al. developed a model for predicting draught, DR [3]. The model incorporates mean air velocity, $\bar{v}$, air temperature, t_a, and turbulence intensity, Tu, in the estimation of the percentage of dissatisfied due to draught. Based on measurements of airflow characteristics in five of the nine investigated spaces, an average of the *DR* index was calculated for each space providing an estimate of the draught rating in the individual space. In figure *2,* the observed percentage of dissatisfied due to draught is compared with the estimated percentage of dissatisfied, predicted by the model. In all spaces the existing draught model underestimated the observed percentage of occupants feeling draught. The model of draught was based on data from experiments with sedentary, thermally neutral subjects dressed in normal indoor clothing. The validated intervals for the physical parameters are: $20 < t_a < 26$ °C; $0 < v < 0.40$ m/s; $0 < Tu < 70$ %. Using the model outside these intervals for estimating the draught rating in industrial spaces is therefore not recommended. Still, the influence of activity level and, in particular, the general thermal comfort level on human sensitivity to draught needs to be studied for evaluating draught risk during physical work in cool environments.

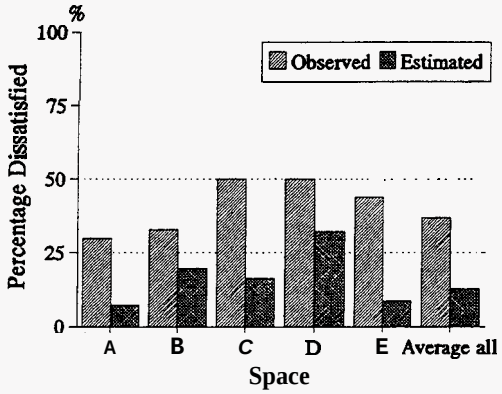

Figure 2. Comparison of observed and estimated percentage of dissatisfied in five spaces.

CONCLUSIONS

A clear relationship between the thermal mean vote and the percentage of persons feeling draught was found. It is therefore important, especially when working stationary in a cool environment, that people feel thermally neutral or slightly warm in order to minimize local thermal discomfort due to draught.

The existing model for predicting draught rating was found to underestimate the percentage of dissatisfied due to draught when applied in industrial environments. The preconditions of thermal neutrality, activity level, clothing and air temperature for using the model was not fulfilled.

ACKNOWLEDGMENT

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